The University of Chicago

THE MEASUREMENT OF BUSINESS ACTIVITY IN THE PUGET SOUND AREA

A PART OF A DISSERTATION SUBMITTED TO THE FACULTY OF THE SCHOOL OF BUSINESS IN CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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By

GRANT I. BUTTERBAUGH

The University of Chicago Press
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PREFACE

BUSINESSMEN, private investors, government officials, and students of economics and business administration are deeply interested in such questions as: "How is business?" "What will the business situation be in the near future?" and "What is the long-term outlook for business?" To help answer these important questions, one needs to have, in addition to a fund of political and economic knowledge, business and economic data of the past which can be examined and studied as a historical foundation for present judgments and future estimates of conditions. Individuals may wish to know the answers to such questions for particular business establishments or specific industries. They may be interested primarily in the general business activity of a local region or of the entire country.

A number of years ago the writer was asked to assist in the solution of a problem which called for an index of business activity for Seattle or for the local area in which Seattle is located, and it was impressed upon him forcibly at the time that nothing of this nature was available. To show how business conditions in Seattle compared with conditions in other regions or with the country as a whole was quite impossible at that time because there were no published indices covering this localized area.

In order to make business decisions involving the planning of future operations, every businessman needs to look beyond his own industry to appraise general conditions in his own region as well as in the nation as a whole. A regional index aids him by condensing into one series the fluctuations of many series of data reflecting the business activity of the local area.

In recent years efforts have been made to provide the many different sections of the United States with regional index numbers measuring business activity. Business publications such as *Dun's Review* and *Business Week* have published these index numbers regularly, and the Babson Institute and other private organizations have published their estimates from time to time.[1] The need and the desirability of regional business indices for Washington or the Pacific Northwest were expressed in the principal editorial of a local newspaper in March, 1940, suggesting that the project of devising such index numbers or some system of reports on business activity is one that might well command the attention both of business groups and of governmental agencies.[2]

The present study has the following chief objectives:

1. To assemble a body of economic and business statistical data pertaining to the fluctuations in trade and industry in the Puget Sound Area.

2. To make available in graphic form, as well as in numerical tables, a large number of series of monthly business data pertaining to the Puget Sound Area statistically treated so as to make all series comparable on a recent base period.

3. To present the results of experimentation in the construction of indices of business activity for a localized region, an economic or trading area which lies within the political boundaries of a state.

[1] Brooke, Smith, French, and Dorrance, Inc., New York.

[2] *Seattle Post-Intelligencer*, March 11, 1940.

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CHAPTER I

INTRODUCTION

STATEMENT OF THE PROBLEM

This is a study in the measurement of regional business activity. It presents the results of experimentation in the construction of indices of business activity for a localized region—specifically, the Puget Sound Area of Washington. The area to which these statistics directly pertain is an economic or trading area which lies wholly within the political boundaries of the state. It seems to be particularly well suited for the experiment of delimitation and measurement because of its definite physical and man-made boundaries and because its principal industrial and trading centers are closely clustered in the heart of the area.

In the presentation of an index of business activity for the Puget Sound Area it is realized that this is but a first approximation and that these measurements are not extremely accurate. This study represents an experiment which is analogous to a preliminary estimation. There are other series which should be included in such an index to give a more complete picture of business, but the desired data are as yet unavailable. Some types of data require the assistance of government agencies for their collection and compilation. Other types are considered confidential either by the government or by those submitting the information to the government and are thus not available to the public. Still other series of data could be had if an organization could be financed to do the work necessary for their collection.

It is not presumed that the method used for statistically treating or assembling the series used in the indices is faultless or that the system of weighting the individual series used in the indices is unassailable. One grave difficulty in such experiments, aside from the tremendous amount of routine machine calculating necessary for even the simplest of composite series, is that the acceptability of the results does not depend entirely upon the statistical method used. The results must check with the logical interpretation of business conditions derived from nonstatistical measurements.

EVOLUTION OF REGIONAL INDICES

The study of regional business problems is not a new departure. There have been many such studies in the past, especially following the period of World War I. The first business indices compiled in this country had nation-wide coverage. As interest in these measurements grew and the methods of time-series analysis were further developed, it was an easy step to the measurement of business activity in smaller and more localized regions of the country. There is a growing recognition of the fact that trade territories rarely coincide with political boundaries; market areas and supply areas do not necessarily correspond with Federal Reserve districts or with state lines. The problem of measurement of regional business conditions embraces the delimitation of these trade areas and the collection of pertinent statistics for analysis.

NEED FOR REGIONAL INDICES

In some states (such as Indiana, Iowa, Kansas, and Nebraska) state-wide figures would be of more value to a local businessman than in a Pacific Coast state, where topographical and climatic conditions divide the states into rather clearly defined economic regions. At any rate, state-wide data are more reliable for the measurement of business activity in the subdivisions of states that have great uniformity of climate and industry than in states which are quite definitely divided into economic sections. Where industries are representative of and show close relationship with national business, even national indices could be used successfully for local planning. While it is true that the small businessman requires a knowledge of local conditions, such an understanding presupposes familiarity with the national situation.

DIFFICULTY OF OBTAINING COUNTY DATA

In addition to the problem of outlining the specific territory to be included in a regional index number series, a major difficulty is that of obtaining desirable series on a county basis so that the data can be restricted to the area to be measured. Some business statistics in this study were available for certain cities only, as, for example, those of department-store sales and bank debits; others were to be had for part but not for all of the counties desired, as in the case of real estate transactions; while others, like gasoline sales and life insurance sales, are compiled for the entire state only. Other data cover all or parts of several states, as, for example, carloadings, cement production, and lumber production. As there is no way to separate the production or sales statistics of the Puget Sound Area from the statistics of the adjoining territory, series representing the electric-power industry cover a slightly larger region than that delimited as the Puget Sound Area.

PROBLEM OF DELIMITING THE AREA

In order to make a study of the business activity in the Puget Sound Area, it is necessary, first, to mark out the boundaries of the specific area of concern. After extended study of prior attempts to delimit the Puget Sound Area, of the topographical features such as the limits of the drainage basis, of population distribution, of the highways, transportation systems, and rate-equalization points, and of the agricultural and industrial pattern of the region, the boundaries were drawn to include the fifteen northern counties out of the nineteen counties which constitute "western Washington."[1] This area is bounded on the west by the Pacific Ocean, on the north by the Strait of Juan de Fuca and the Canadian boundary, on the east by the Cascade Mountains, and on the south by the southern border of Pacific and Lewis counties (see Fig. 1). The other four "western Washington" counties omitted were considered to be part of the Portland, Oregon, trade area, owing to shorter distances and lower freight rates.

MODIFICATION OF BOUNDARIES IN SPECIFIC INSTANCES

Although the boundaries of the Puget Sound Area have been set to include the northern fifteen counties of western

[1] See U.S. Department of Commerce, Bureau of Foreign and Domestic Commerce, *Market Data Handbook of the United States* ("Domestic Commerce Series," No. 30 [Washington: Government Printing Office, October, 1929]). Here are shown maps of "Wholesale Grocery Trade Territories," "Retail Shopping Areas," "Trade Areas for Budgetary Control Purposes," and "Consumer Trading Areas" prepared by the Department of Commerce and various national advertising companies.

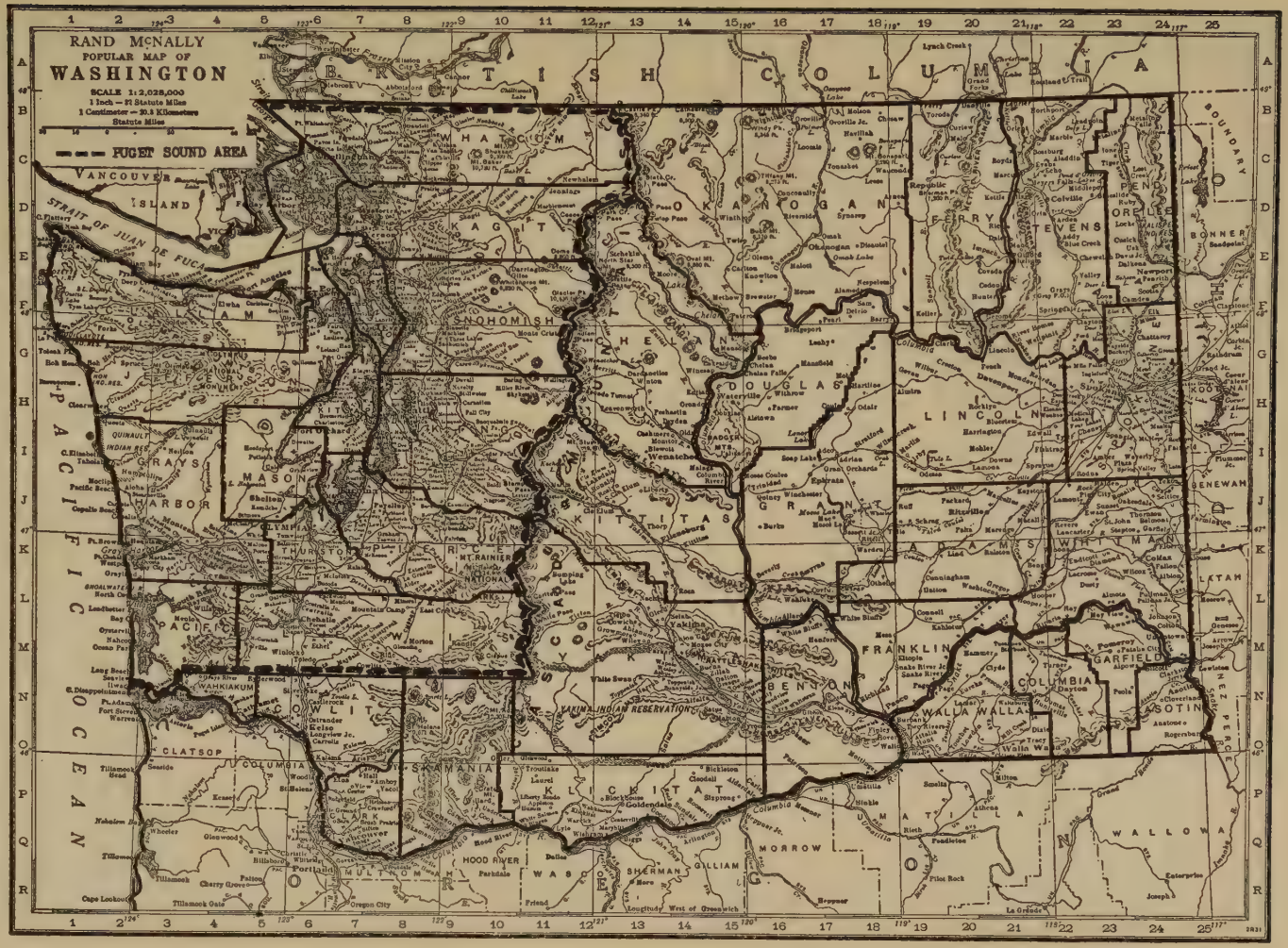
RAND McNALLY
POPULAR MAP OF
WASHINGTON
SCALE 1:2,025,000
1 Inch = 31 Statute Miles
1 Centimeter = 20.5 Kilometers
Statute Miles
PUGET SOUND AREA
BRITISH COLUMBIA
VANCOUVER ISLAND
STRAIT OF JUAN DE FUCA
PACIFIC OCEAN
WHATCOM
SKAGIT
SNOHOMISH
CHELAN
OKANOGAN
FERRY
STEVENS
PEND OREILLE
BONNER
KOOTENAI
ISLAND
SAN JUAN
JEFFERSON
CLALLAM
KITSAP
MASON
GRAYS HARBOR
PACIFIC
THURSTON
LEWIS
PIERCE
KING
DOUGLAS
GRANT
LINCOLN
ADAMS
SPOKANE
WHITMAN
BENTON
FRANKLIN
GARFIELD
COLUMBIA
WALLA WALLA
ASOTIN
YAKIMA
KITTITAS
WAHKIAKUM
CLATSOP
COWLITZ
SKAMANIA
KLICKITAT
HOOD RIVER
WASCO
SHERMAN
GILLIAM
MORROW
UMATILLA
WALLOWA
MULTNOMAH
CLARK
Portland
Vancouver
Seattle
Tacoma
Spokane
Yakima
Olympia
Everett
Bellingham
Aberdeen
Longview
Kelso
Wenatchee
Ellensburg
Pullman
Colfax
Walla Walla
Dayton
Goldendale
The Dalles
Hood River
Pendleton
La Grande
Enterprise
Joseph
Moscow
Lewiston
Clarkston
Republic
Colville
Kettle Falls
Chewelah
Newport
Sandpoint
Priest River
Metaline Falls
Grand Coulee
Soap Lake
Ephrata
Moses Lake
Othello
Connell
Kahlotus
Dayton
Waitsburg
Prosser
Sunnyside
Toppenish
Wapato
Naches
Cle Elum
Roslyn
Ellensburg
Kittitas
Thorp
Cashmere
Leavenworth
Chelan
Entiat
Waterville
Wilkeson
Mount Rainier
National Park
Mount Adams
Mount St. Helens
Mount Baker
Glacier Peak
Olympic Mountains
Cascade Mts.
Columbia River
Snake River
Yakima Indian Reservation
Colville Indian Reservation
Spokane Indian Reservation
Coeur d'Alene Indian Reservation
Kalispel Indian Reservation
Quinault Indian Reservation
Quileute Indian Reservation
Makah Indian Reservation
Lummi Indian Reservation
Nooksack Indian Reservation
Swinomish Indian Reservation
Tulalip Indian Reservation
Port Gamble Indian Reservation
Skokomish Indian Reservation
Puyallup Indian Reservation
Nisqually Indian Reservation
Chehalis Indian Reservation
Shoalwater Indian Reservation
Columbia Indian Reservation
Umatilla Indian Reservation
Colville Indian Reservation
Spokane Indian Reservation
Kalispel Indian Reservation
Coeur d'Alene Indian Reservation
Yakima Indian Reservation
Quinault Indian Reservation
Quileute Indian Reservation
Makah Indian Reservation
Lummi Indian Reservation
Nooksack Indian Reservation
Swinomish Indian Reservation
Tulalip Indian Reservation
Port Gamble Indian Reservation
Skokomish Indian Reservation
Puyallup Indian Reservation
Nisqually Indian Reservation
Chehalis Indian Reservation
Shoalwater Indian Reservation
Columbia Indian Reservation
Umatilla Indian Reservation

FIG. 1

Washington, it will be necessary to modify the boundaries of the Area for some of the series presented, because the data are available only for regions overreaching the boundaries of the Puget Sound Area. Coal production, for example, will include Kittitas County as well as the fifteen counties of the Puget Sound Area as originally delimited. Gasoline sales (prepared from the sales tax), life insurance sales, and factory employment and pay rolls are series representing the entire state of Washington, since these data are unavailable by counties. Lumber production is for the western coast of Washington and Oregon. One electricity sales series will cover more territory than that designated as the Puget Sound Area. Except for these series, all data used in the indices of business activity are for separate counties and cities which can be allotted to the specific territory being measured.

CHAPTER II

BUSINESS AND ECONOMIC TIME SERIES PERTAINING TO THE PUGET SOUND AREA

TYPES OF FLUCTUATIONS AFFECTING DATA

It is one of the principal objectives of this study to bring together in one place a large number of economic and business series pertaining directly to a localized region of the country statistically adjusted in such a way that each series might be directly compared with any one of the others.[1] The selection of a uniform base period makes it possible to compare two or more series on the same chart without further statistical manipulation. It is thus easy to judge visually the lead or lag of one series compared with another by plotting the series to be compared on separate sheets of paper and then shifting them backward and forward over one another before a light until the average lead or lag is determined.

If other business series are to be compared with any of those given herein, the index numbers would necessarily have to be computed in the new series with the same base period, although the technique of adjusting the data and measuring the seasonal variation would not have to be precisely the same.

It would seem to be a point which needs to be given only a passing word of recognition that original economic and business data require some adjustment before they can be used safely for making decisions based on comparisons of one period with another. This is due to the fact that there are several kinds of changes or fluctuations taking place from day to day, month to month, and year to year which may make them noncomparable. One example of fluctuations in data is the variation from month to month owing to the length of the months. Another example of fluctuation in data is that caused by the changing seasons of the year. Finally, a change in the population, the discovery of new methods of production, or the exhaustion of a source of raw materials may cause a change in the basic trend of the data.

Seasonal variation.—If seasonal variation is not removed from a time series, incorrect conclusions might be drawn as to the reason for the changes in the data. For example, the volume of eggs produced in the summer months drops, owing to biological reasons. This movement might be attributed to a falling-off in business due to depression factors if its seasonal character were not recognized. In appraising retail trade statistics, to cite another case, it might be very difficult, if not impossible, to get a clear idea of the change in volume of business due to business-cycle influences if allowance were not made for the customary seasonal increase due to Easter and Christmas buying. It is necessary, then, when using such data as are presented herein, to measure the seasonal variations and to eliminate them from the data, that is, to adjust the original data for seasonal variations.

Seasonal index numbers represent the typical monthly fluctuations within the

[1] All series mentioned later in this chapter are shown in graphic and tabular form in an unpublished doctoral thesis by the author, "The Measurement of Business Activity in the Puget Sound Area" (University of Chicago, 1942).

year. Since actual seasonal variations do not occur in exactly the same way year after year, the pattern of seasonal variation that is sought is simply the average seasonal pattern of a number of years. If the seasonal pattern is not changing progressively from year to year, the average seasonal index numbers may be used to eliminate the seasonal patterns from the entire series; but, where changes are taking place in the seasonal pattern, the measurement of seasonal fluctuations may require breaking the series into two or more subseries to find the seasonal index numbers for each of these subseries. If this is not feasible, it is possible to compute a changing seasonal, that is, a series of index numbers representing the seasonal variations with a gradually changing index number for each month throughout the entire time series.

Secular trend.—Another type of fluctuation peculiar to time series is the secular trend inherent in nearly all series of business and economic data. The long-time trend indicates whether the data are rising over a relatively long period of years, as is indicated in the electricity sales series, or falling, as in the series of egg prices. The long-time trend is a rather arbitrary interpretation based upon the conception of growth or decline over a sufficiently long period of time to give a reasonably correct idea of such change. As the long-time trend is altered by each added item of data, it is clearly a matter of judgment as to what period and what type of trend line should be used to represent the trend of the series. In some series of business data, such as building construction and real estate transactions, there are long cycles of from fifteen to twenty or twenty-five years which may cover several general business cycles. Care must be exercised in measuring the long-time trend of such series in order that the swing of the long cycles not be confused with the long-time trend of the series. A relatively longer series would be required in order to allow for these long cyclical movements in determining the trend. Since it is sometimes desirable to study the combined effects of trend and cyclical movement, the long-time trend is not always removed from the data. Moreover, the series may be too short for proper measurement of the trend, or the available data may be entirely from a period which does not lend itself to proper trend measurement. However, these fluctuations should be recognized even though their measurement may need to be postponed until additional data can be obtained. The principal reason for attempting removal of trend from data is to reveal more clearly the residual of combined business-cycle and random fluctuations in the time series.

Cyclical fluctuations.—The present generation, both inside and outside the so-called "business world," has been made fully aware of the presence of the business-cycle movement through the constant discussion of depression and the ways and means of bringing back a period of prosperity. The recurring changes from prosperity to boom, through crisis and slump to depression, through liquidation to revival, and recovery of prosperity—sometimes called "back to normal"—are well known. It is a primary purpose of the analysis of time-ordered data to measure and then to remove from the original data the influences of other factors, so that such data will give the clearest obtainable picture of the business-cycle fluctuations. The general methods and refinements in the statistical techniques for accomplishing this end are numerous and varied, but they all have the same goal in view, namely, to see how

business stands as related to either a computed "normal" or to some arbitrarily accepted "base period."

Random fluctuations.—Occasionally business is given a sudden rude shock which upsets the even tenor of its way. Fluctuations of a random nature cannot, as a rule, be foretold very long in advance, if at all. Random fluctuations are quite the opposite of the seasonal fluctuations, which can be counted upon even though they may be undergoing a definite shifting process. Such occurrences as waterfront strikes, disastrous fires, destructive earthquakes, floods, wars, embargoes, robberies, or even a world's fair inject for a brief, but sometimes for a comparatively longer, period the type of interference known as "random fluctuations."

Random fluctuations are usually left combined with the residual which results from the removal of long-time trend and seasonal fluctuations from the data, and thus what is called the "measure of business" contains within it these random fluctuations as well as those caused by the changes in the business cycle.

Calendar variations.—The vagaries of the Gregorian calendar are a source of annoyance to those who are interested in making accurate comparisons between the statistics of different years, months, or weeks. Unless adjustment is made for the number of days in the months, for the number of holidays, Sundays, Saturdays, or working days, as required by the data, comparability within and between the series of data is impaired.

Purchasing power of the dollar.—Another type of change which must be recognized is that occasioned by the changing purchasing power of the dollar. The amount of labor services or materials that can be purchased with a dollar is noticeably different from one time to another, and yet it would be an exceptional business which attempted to adjust its books of account or its other statistical records for this type of fluctuation or which made allowance for these changes when using the data provided by its records. The difficulty of adjustment here is to obtain an appropriate measure of the change in the purchasing power of the dollar by which to "deflate" or adjust the data which it is intended to analyze. The construction dollar is not the same thing as the telephone dollar, and these differ greatly from the retail sales dollar, the wholesale dollar, and the transportation dollar. The yardsticks not only are different from one field to another but are not fully reliable as between one section of the country and another. The purchasing-power index of the construction industry in New England is not necessarily of value in the Pacific Northwest, owing to differences in proximity to raw materials, labor supply, etc. A national index of purchasing power for the wholesale field is not applicable in localized areas, because the business conducted locally may for the most part be either unrepresented or inadequately represented in the national purchasing-power index.

The inadequacy of measures of the changing purchasing power of the dollar is not a good reason for ignoring the fact that the changes do exist and theoretically should be eliminated from all data expressed in dollars and cents. Although the theory of such adjustment is sound, the attendant difficulties spur statisticians to seek representative series expressed in comparable physical units wherever possible. The use of kilowatts of electricity produced or sold is to be preferred to the dollar revenues of the power companies; the number of passengers carried is more desirable as a measure of ferry or street transit travel than

the passenger revenues. To use another example, newspaper advertising lineage is superior to the amount of advertising revenue because of the comparability of the unchanging statistical unit of measurement. It does not follow invariably, however, that physical units are preferable to dollar values even when adjustment for purchasing power is not attempted, for sometimes the units are so varied that they cannot be counted with reasonable success, as, for instance, department-store sales. Again, a series like bank debits would of necessity have to be expressed in dollars and cents.

The influences so far mentioned have been seasonal variations, long-time trend, business cycle, random fluctuations, calendar variations, and changing purchasing power of the dollar. These are the principal influences met with in the general run of business and economic time series. Of course, other types of changes could be added which affect particular series; for example, there is the biological cycle which influences the run of salmon with recurring heavy runs in two-, three-, and four-year periods. Reference has been made also to the long cycles in building construction and real estate data which may cover periods of from fifteen to twenty-five or more years. In forestry and agriculture there are cycles of insect pests which cause damage and loss. For the most part, however, the bulk of the statistical manipulation of data in time-series analysis is concerned with calendar and purchasing-power adjustments of the data and with the measurement and subsequent removal from the original series of the long-time trend and the seasonal variation. Through these procedures the more readily measurable changes in data are eliminated from the series in order to permit the influences of the business cycle and random fluctuations to stand out in bolder relief. The methods used for statistical adjustment of the data presented are explained in chapter iii in the section headed, "Statistical Methods Used in Adjustment of Series."

In the computation of composite index numbers two methods of measurement and adjustment have been used: first, series adjusted for the calendar and for seasonal variation and, second, the same series with further adjustment for long-time trend. As suitable purchasing-power deflators were unavailable, dollar-value series have been avoided as far as possible in compiling the composite index numbers, and physical-unit series were used wherever obtainable.

CLASSIFICATION OF THE SERIES

In order to show clearly the types of data being presented and to make their description easier, the various series have been grouped into several broad classifications, namely, "Production," "Trade," "Transportation and Shipping," "Financial," "Real Estate and Building," and "Prices and Cost of Living." The main divisions and the series pertaining to each are as follows:

A. Production
- Cement production
- Coal production
- Electricity sales
- Factory employment
- Factory pay rolls
- Fish landed—pounds
- Fish landed—value
- Lumber production

B. Trade
- Department-store sales
- Flour receipts
- Gasoline sales
- Livestock receipts—cattle, hogs, sheep
- Livestock slaughtered—cattle, hogs, sheep
- New-car registrations
- Newspaper lineage
- Postal receipts

Telephones in service
Telephone long-distance calls
Wheat receipts

C. Transportation and shipping
Carloadings
Egg shipments
Exports to Alaska—value
Exports and imports—total tonnage
Exports and imports—total value
Exports—value (Washington District)
Imports—value (Washington District)
Ship departures to Alaska from Seattle
Street transit system passengers
Tourists—Mount Rainier National Park

D. Financial
Bank debits
Bank deposits
Business failures—number
Life insurance sales

E. Real estate and building
Building permits—number
Building permits—value
Real estate transactions—number
Real estate mortgages—value
Real estate mortgage foreclosures—number

F. Prices and cost of living
Cost of living
Food prices
Livestock prices—cattle, hogs, sheep
Produce prices—eggs, milk, poultry
Wheat prices

DESCRIPTION OF SERIES, SOURCES OF DATA, AND METHODS OF COMPILATION

A. PRODUCTION

Cement production.—Cement statistics were obtainable by months from the year 1926 through 1939. Cement production shows the amount of cement in thousands of barrels produced in the combined states of Washington and Oregon. Owing to the confidential nature of the data, the government does not publish the statistics of the two states separately. In the Puget Sound Area cement is produced by two plants in King County and one each in Skagit and Whatcom counties. Two other counties in the state manufacture cement, and there are three plants in Oregon. Thus, the Puget Sound Area contains four of a total of nine plants located in the two states.

The cement-production series was obtained from the *Minerals Yearbook*, and, as this publication is always a year late, the series was brought up to date from figures appearing in the *Commercial and Financial Chronicle*.[2]

For the purpose of measuring long-time trend in production, the series appears to be long enough to permit a reasonably good description by use of a straight line. As examination showed there had been considerable change going on in the seasonality of production, a changing seasonal was computed. This series is not a strong one from the standpoint of measurement of business activity in the Puget Sound Area because of the relatively large territory covered and because of the lack of concentration of the industry in the Puget Sound Area.

Coal production.—Coal-production statistics in the state of Washington are available on an annual basis from the year 1860, when 5,374 tons were mined. Coal production passed the million-ton point in 1888 and reached a peak production in the years 1917 and 1918, when over four million tons were mined. Since that time the output has decreased, and in 1939 it amounted to 1,695,701 tons. Coal-production data were obtained from the Department of Labor and Industries of the State of Washington, State Mine Inspector's Office. Monthly data were available in mimeographed form commencing with the year 1937. No data on a monthly basis were available before the

[2] U.S. Department of the Interior, Bureau of Mines, *Minerals Yearbook* (Washington: Government Printing Office, 1929–39), for the years 1928–38, and *Commercial and Financial Chronicle* (New York: William B. Dana Co.), for 1939 statistics.

year 1932. For the years 1932–36, inclusive, it was necessary to compile the data from a mines ledger posted from the individual monthly mine reports. Reconciliation was made between data so compiled and the *Annual Report of Coal Mines* issued by the Chief Mine Inspector.[3]

The term "coal production" as used in these mining statistics is not the actual amount of coal mined but is the coal which is shipped to customers, sold to employees and local trade, and used for power. Although it might at first appear that the series is weakened by reason of our inability to determine periods of building-up of inventories, it is a characteristic of coal-mining in Washington that there are no periods of heavy production to build up stock, for the reason that coal can be mined at all seasons of the year. Therefore, the coal is mined as required and thus production of coal virtually equals shipments, that is, consumption.[4]

The boundaries of the Puget Sound Area were enlarged as far as coal production is concerned to include Kittitas County. This county produced about 43 per cent of the coal mined in Washington in 1939 and about 46 per cent of the total in 1940. As Kittitas County is the largest producer of coal in the state and lies just east of King County and the Puget Sound Area as delimited, and as the coal is shipped westward principally for use by the railroad which owns the chief producing mines, it was felt it should be included in the Puget Sound Area.

As monthly data, this series is too short to reflect the long-time trend in coal production accurately, but the annual data show that the industry has had a downward trend since its peak in 1917–18. In using this series in the composite index where trend was removed, total annual production figures from 1920 to 1939 were used to determine a straight-line trend equation which was then reduced to a monthly basis to permit its removal from the calendar and seasonally adjusted series. An approximation of the seasonal variation has been computed, but the shortness of the monthly series does not give an opportunity for great accuracy in this measurement. In general, there is a recurring winter peak and a summer lull in the mining of coal in this area of the country.

Electricity sales.—The use of electric power in manufacturing and mining is almost universal at the present time. In recent decades the substitution of electrically driven machinery and hand tools for steam, gas, and man-powered equipment has been rapid and far-reaching. However, in some industries, such as fishing, logging, and agriculture, considerable use is made of manual labor and gasoline engines, and for this reason electric-power production gives undue weight to highly mechanized factory-type industries which use a large amount of electric power compared to the nonfactory industries which use considerable labor, augmented by gasoline or oil-burning power plants. Nevertheless, the electric-power production series forms an advantageous index of production. The fact that it is expressible in a physical unit of universally acceptable and unchanging meaning is in its favor. This is an advantage, because there have been rate changes the effects of which it would be difficult, if not impossible, to measure and allow for. These rate changes would

[3] Washington State Department of Labor and Industries, *Annual Reports of Coal Mines, for Years Ending December 31, 1938 and December 31, 1939* (Olympia: State Printing Plant, 1939–40).

[4] Statement by Professor J. Daniels, School of Mines, University of Washington, in a personal interview.

need to be considered if revenue series were used.

In the Puget Sound Area the abundance of electric power means that new plants start life with electrically driven equipment, and the question of replacement of manual labor or steam plants by electric machinery, which might be an erratic element in older manufacturing districts, is not important here. There is no natural gas, and relatively little use is made of manufactured gas in the operation of industry in the Area. Electricity production reflects activity in nearly all branches of business, including manufacturing, mining, street and railroad transportation, and commercial trade; but, since electricity is universally used in the Area for light and power in the home, it reflects the prosperity of private consumers as well as that of commercial and industrial users.

The principal power and light utilities in the Puget Sound Area are the privately owned Puget Sound Power and Light Company and the two municipal lighting departments of the cities of Seattle and Tacoma. These three public utilities cover the main industrial sections and the chief cities of the Area. The Puget Sound Power and Light Company competes with the Seattle Department of Lighting in the city of Seattle but offers no competition to the Light Division in Tacoma. For the period covered in this study the power produced by the three companies covers nearly all the power produced in the Area, but eventually power from the two huge government projects—Bonneville and Grand Coulee —will be in competition with the local producers.

It is admitted that the Seattle Department of Lighting serves principally residential customers and that the Puget Sound Power and Light Company has a greater part of the commercial and industrial service. The sales of the privately owned utility are the aggregate of its entire territory, which extends from Seattle southward 150 miles to Longview and Kelso, in Cowlitz County, passing through Renton, Auburn, Puyallup, then in a circle around Tacoma, through Olympia, Centralia, and Chehalis. It extends northward 125 miles to the Canadian border through Everett, Mount Vernon, and Bellingham; to the northwest, connecting with Bremerton, Port Townsend, and Port Angeles; and eastward across the Cascade Mountains to Ellensburg and Wenatchee. In Tacoma the public utility serves all the consumers in the city, including commercial, industrial, and residential. It has been pointed out that the Tacoma seasonal index curve is a close approximation of a composite curve of both the Seattle utilities, for the above reason that the Tacoma Light Division serves all types of users, while the two Seattle companies have a preponderance, in one case, of residential customers and, in the other, of commercial and industrial customers.[5]

Although there are small plants serving the Grays Harbor and Willapa Harbor cities, a municipal plant at Centralia, and private hydroelectric plants operated by the Great Northern Railway and the Chicago, Milwaukee, St. Paul and Pacific Railway for electrification of these lines through the Cascade Mountains, it is safe to say that the loss of sales in this direction is largely offset, though the error is not entirely corrected, by the added sales made by the privately owned Puget Sound Power and Light Company in its operations outside the Puget Sound Area.

The three electricity sales series were obtained from the offices of the producing

[5] Letter from E. C. Brundage, statistician, Department of Lighting, Seattle, April 17, 1940.

companies. The series of the Department of Lighting, city of Seattle, was prepared in the Statistician's Office of the department for the period 1922 through 1936. Data for the years 1937, 1938, and 1939 were taken from the anual statements of operating revenue and energy delivered. For the years 1933–39, inclusive, the figures were in net monthly kilowatt-hour deliveries. In all other years prior to 1933, rebates were shown in totals at the end of the year. To arrive at figures corresponding to the period following 1932, it was necessary to divide the rebates by twelve and deduct a proportionate amount from each month of the year. It was also necessary to handle the miscellaneous current and self-consumed current in the same manner, adding the fractional amount instead of deducting it.

The Puget Sound Power and Light Company series by months in megawatts was obtained through the Chief Engineer's Office for the period from 1929 to September, 1937, and was compiled for 1925–28, inclusive, and from October, 1937, through 1939 in the Treasurer's Office of the company. Data prior to 1925 were not available, owing to accounting classification complications and to consolidations and mergers within the company structure.

The Tacoma series covering the years 1931 through 1939 by months was obtained from the records of the Light Division of the Department of Public Utilities of Tacoma.

These three monthly series represent the amount of electricity actually being sold to consumers of all kinds, including industrial, commercial, farm, residential, and street-lighting services. It is a well-known fact that some electricity is lost through transmission resistance, which gives data covering sales or consumption the advantage of showing the amount of electricity finally going into the service of consumers. Of course, in the present case, the series have the disadvantage of including other services than industrial and commercial, a fault which could not be avoided because of the way in which the statistics have been kept in the co-operating companies. If it were possible to obtain homogeneous series from the principal power companies for commercial and industrial purposes alone, the electricity sales series would be better measures of production. Residential uses of electricity have been increasing rapidly in the Area during the last ten years. Industrial uses undoubtedly have increased on the whole but not so rapidly as residential uses. The figures are not readily available in relevant segregation, since two of the companies are city utilities and the other is a private company; the records are classified by different bases.

Factory employment and factory pay rolls.—Two series of index numbers are presented covering factory employment and factory pay rolls for the state of Washington and two series covering factory employment and factory pay rolls for the Pacific Coast. The latter two series are included solely to permit comparison with the combined Pacific Coast area. The impossibility of obtaining employment and pay-roll data by counties prevents separation of the Puget Sound Area from the balance of the state. These index series are prepared by the Federal Reserve Bank of San Francisco and are published in its *Monthly Review of Business Conditions in the Twelfth Federal Reserve District.* All these series are monthly from 1929, are adjusted for seasonal variation, and have a base period of 1923–25 average equal to 100 per cent. It should be noted that the series exclude data from the fruit-, vegetable-, and fish-

canning industries and have been computed by a very complex and involved procedure, owing to scarcity of information and data.

As a measure of productive activity, man-hours worked is superior to number of employees and pay-roll totals, but man-hour statistics are not available for the state of Washington. Pay-roll totals are used to indicate labor costs and as a measure of purchasing power, but they have the disadvantage of being in dollars and cents and thus subject to the varying purchasing power of the dollar. Number of employees shows the number with jobs and is useful in problems concerned with relief needs and unemployment but does not respond quickly to changes in business activity in all types of industry.

In order to make the employment and pay-roll series conform to the base of all the other series, they have been converted from their original base of 1923–25 = 100 to the base 1935–37 = 100 by dividing them by the 1935–37 monthly average. According to the Census of Manufactures, about 74 per cent of the wage-earners and 75 per cent of the pay rolls in manufacturing in Washington were attributable to the Puget Sound Area in 1939.

Fish landed (pounds and value).—Two monthly series for the years 1929–39, inclusive, representing fish landed at Seattle, give a measure of the fishing industry in the Puget Sound Area. Seattle is the chief wholesale market for fish and the home of a large part of the halibut- and salmon-fishing fleets of the Pacific Northwest. While the greater part of salmon-packing is now carried on in Alaska, and the salmon is shipped largely to Seattle for sale and transshipment, approximately 47.4 million pounds of fresh fish of all kinds were landed at Seattle during 1939. The value of these fish was reported as approximately $3,223,450.

Two series are shown—total fish landed in pounds and total fish landed in value. Fish-landed series include all fish caught and landed at Seattle by United States vessels, known as the "Halibut Fleet," plus receipts by Seattle wholesale dealers. These data include fish caught in the waters of Puget Sound, the Strait of Juan de Fuca, and offshore fishing in the Pacific Ocean, but do not include fish received from Alaska or Canada.

The series of pounds of fish landed does not have the disadvantage of dollar fluctuations but is composed of seventeen separate series, that is, seventeen kinds of fish, ranging from the comparatively small smelt to the enormous halibut and tuna and from the shrimp to the octopus. In recent years fishing for tuna has increased in these northern waters, and it was added to the fish reports commencing in August, 1938.

The usefulness of the series of dollar value of fish landed is subject not only to the fact that it is a combination of seventeen series of products at various values but also to the fact that the purchasing power of the food dollar is constantly changing. It is logical that, as economic conditions vary, the dollar will buy more or less fish and that the dietary habits of the people are subject to constant change as they are influenced by economic changes in the meat-raising and meat-packing industries. Such a series expressed in dollar values theoretically should be deflated by dividing it by an appropriate index measuring the changes in purchasing power of the food dollar in the area represented by the original data.

Fishery statistics for this region are collected and reported by various agencies of the state and federal governments.

Those used in this study were compiled by the Department of the Interior's Fish and Wildlife Service and reported in a monthly bulletin covering landings at Seattle by the Halibut Fleet, receipts of the Seattle wholesale market, and the catch by the Halibut Fleet in the "open areas."

It is to be regretted that no definite measure can be obtained of the salmon-packing industry of Alaska by months or of the monthly shipments of canned salmon from Seattle by rail, water, and truck. During the extremely busy packing season which covers the summer months, it has been difficult to obtain monthly data from packers, since they are under no obligation to make reports of their operations. The result has been rather unreliable annual totals of salmon packed. Accurate monthly totals of canned salmon produced in Alaska are not to be had at present.

The *Survey of Current Business* carried a series for many years showing the shipments of salmon from the Pacific Coast which was a fair measure of the salmon industry; unfortunately, this series was discontinued in 1939.

Lumber production.—Lumber production is the principal industry of the Puget Sound Area and is of major importance in the Pacific Northwest states of Washington and Oregon. The series of monthly data presented here, from 1929 to 1939, inclusive, is an important indicator of business activity and of the general economic health of the Area.

It is particularly regrettable that comparable production figures in this major industry of the Area are not obtainable from any source prior to 1929. Data released by the West Coast Lumbermen's Association cover the production of lumber on the western coast of Washington and Oregon, that is, west of the Cascade Mountains. The series presented is computed as the average weekly cut in thousands of board-feet. As calculated by the association, the number of weeks in a month varies from four to five. If a week at the beginning or end of a month includes Wednesday, it is counted as a full week. The production, or cut, is computed by dividing the production of 151 mills, members of the association, by a percentage thought to be equal to the relation the production of these 151 mills bears to the total production of the western coast area. In recent years 80 per cent has been used as a divisor, but in 1939 a slightly lower percentage was used. It is not possible for the association to obtain the output of all mills in the region, since they do not all belong to the association. Furthermore, the number of mills in the association is subject to change from month to month. The percentage used as a divisor of the production of the 151 comparable mills is calculated to bring the production of this uniform number of mills up to the level of complete coverage. Prior to 1929 the data were based on 124 of the largest Washington and Oregon mills, so that the series prior to 1929 is thus not comparable with the new one begun in 1929. In using these data, it should be noted that there was a drop in production due to the longshoresmen's strike of May, June, and July, 1934; the sawmill workers' strike of May, June, and July, 1935; and the maritime and longshoremen's strike from November, 1936, to February, 1937.

The period covered by the lumber-production series was so unsettled that it was decided to compute a changing seasonal index. Moreover, the period was so short and the fluctuations of the series were so erratic that measurement of long-time trend was extremely hazardous.

Further discussion of this point will be found in the description of the composite indices in chapter iii.

B. TRADE

Department-store sales.—As a measure of trading activity and retail distribution, department-store sales statistics are well recognized and frequently used by businessmen. In the metropolitan areas department-store sales are good indicators of retail trends because the wide range of products sold affects almost every kind of production. Consumer habits and preferences are reflected accurately and sensitively in the merchandise carried by large department stores. Although department-store sales comprise but a fraction of the total volume of retail sales in an area such as the one under study, and are in the nature of a small sample of the retail business activity, such a series is undoubtedly the best available monthly measure of retail trade, covering a reasonably long period of years, to be had in the Area.

The department-store sales series presented herein are for the combined department stores of Seattle, for the combined department stores of the Pacific Northwest, and for the combined department stores of the Twelfth Federal Reserve District. The Pacific Northwest and Twelfth District series are shown simply for their interest and to permit comparison. Department-store sales in dollar values are not available, since they are held confidential by the Federal Reserve Bank of San Francisco, to which they are reported monthly. On the first of each month the Federal Reserve Bank reports the department-store sales in its *Monthly Review* as index-number series. Index numbers of department-store sales are published both unadjusted and adjusted for seasonal variation, calendar variation, and for the shifting date of Easter. By converting the series from the base of 1923–25 average = 100 per cent, on which they were computed, to the base 1935–37 average = 100 per cent, they have been made comparable to all the other series presented in this study.

It would be advantageous to those particularly interested in retail trade activity to have a series representing the chain grocery and mail-order business of the Area, but to date such information has not become available. The Bureau of the Census issues a monthly report of retail sales covering the principal cities of the Area and of the state as a whole, but the series covers only the period from August, 1937. Even though the series were long enough to permit measurement of seasonal variation and long-time trend, it has several disadvantages. In the first place, it does not cover the same number of stores each month; second, it does not cover the same stores each month; and, third, it does not cover the same cities each month.

While department-store sales are good indicators of retail business in the metropolitan areas, it is evident that the smaller urban centers and rural areas are not represented and would require series covering the activities of chain stores, variety stores, dry goods and general stores, and mail-order houses. The new series of the Bureau of the Census is a broader measure of retail business than the department-store sales series alone and may eventually supplant these older series.

The department-store sales series cover the period from 1919 through 1939 converted as indicated above from the revised form in which these index numbers were published in October, 1939, by the Federal Reserve Bank of San Francisco.

Flour receipts.—Two monthly series of carload receipts of flour are presented. These show the flour receipts at Seattle and the flour receipts at Tacoma. The Seattle series dates from January, 1919, and the Tacoma series from 1920. All data were compiled from the daily reports of the Seattle Grain Exchange. These flour receipts series are not particularly important, since they would have to be combined with figures for flour milled in Seattle and Tacoma; and exports and shipments out of the Area would have to be eliminated before any significant idea of flour consumption in the Area could be had.[5a] However, such data may be of use to give an indication of what is happening in the shipping of flour-milling products into the main ports and cities of the Puget Sound Area. Flour receipts data, although defective, are nevertheless of historical value and might become of value in special studies.

Gasoline sales.—When business conditions are favorable and purchasing power is increasing, more gasoline is sold throughout the country. Until recently there was no published statement of the amount of gasoline sold in the state of Washington, but through conversion of the gasoline sales tax collected by the State Treasurer's Office this gallonage can be obtained. In order to obtain a series measuring the gasoline sales for the Puget Sound Area alone, it would be necessary to have the sales tax by counties. As sales-tax statistics covering gasoline sales are reported for the entire state only, the converted series is weakened as a measure of business activity in the Puget Sound Area. About two-thirds of the passenger cars and one-half of the trucks and busses in the state were registered in the Puget Sound Area in the years 1939 and 1940. It is a safe estimate, therefore, that at least two-thirds of the gasoline sales of Washington are made in the Puget Sound Area. While the exact influence of changes in tax rates and gasoline prices can never be measured precisely, being similar to the rate situation in postal receipts, a measure of the gasoline sales is nevertheless an interesting and valuable measure of trading activity, for the reason that gasoline is used in the conduct of many kinds of business, for transportation to and from places of business and market centers, and in making the innumerable deliveries of economic goods. Gasoline sales, like electricity sales, seem to be a general over-all measure of purchasing power because of general use by individuals and business concerns. It is not a series which varies directly with the economic condition of individuals but in the main acts as an indicator of general business conditions.

Gasoline sales fluctuate with the number of cars being operated, which depends upon the changes in population, the financial condition of the people, extension of roads, the price of gasoline, the burden of real estate property taxation inside corporate limits, and general production. Much gasoline is used to operate boats, farm and mill equipment, and construction engines. Just how much of the gasoline consumption is attributable to industrial and commercial purposes is not ascertainable by months at this time, but the approximate amount of the annual consumption can be determined from the refunds made to commercial and industrial concerns. The gasoline-sales series presented herein was derived from the gross tax receipts, since this gives a measure of the aggregate amount of gasoline

[5a] The greatest percentage of the flour consumed in the Puget Sound Area is milled in the Area, the largest factors in this market being two large mills in Seattle and one mill in Tacoma (letter from K. Fisher, advertising manager, Fisher Flouring Mills Co., Seattle, Washington, April 13, 1940).

used, whereas, if the refunds were deducted, the series would give considerably less than the amount of gasoline used in the state.

In the year ending March 31, 1940, the gross collection of gasoline taxes in Washington amounted to $17,516,323.22 and refunds to $1,360,248.99, or 7.77 per cent. This means that, at five cents per gallon tax, 350,326,464 gallons were sold

TABLE 1*

NUMBER AND PERCENTAGE OF REFUNDS TO GASOLINE USERS IN WASHINGTON FOR YEAR ENDING MARCH 31, 1940

Type of Claimant	Number	Percentage
Farms and orchards	13,246	41.27
Sawmills and logging	1,404	18.11
Road and bridge contractors and government construction	208	13.08
Marine and fishing	3,164	9.22
Municipal, including cities and counties	138	5.44
Aviators	69	4.69
Railroads	22	2.45
Building contractors	90	1.40
Mining and well-drilling	172	1.15
Manufacturing	76	0.66
Export	19	0.61
Golf courses	63	0.23
Miscellaneous	614	1.69
Total	19,285	100.00

* Source: *Annual Report of State Treasurer's Office, 1940.*

and that users of gasoline were refunded the tax covering 27,204,980 gallons. Among the 19,285 claimants for refunds, 13,246 were farms and orchards, amounting to over 41 per cent of the refunds. Refunds were made to users of gasoline in the fields of business shown in Table 1, the percentages showing their importance as users of gasoline in the state of Washington.

A new series has recently become available through a monthly report of the Department of Licenses, Olympia, showing the taxable gallonage of liquid fuel products distributed in Washington upon which a five cents per gallon tax has been paid to the state and a total of all gallonage distributed by companies during the month. This series can be obtained by months from 1929, but it does not show the sales by counties; it shows only total sales by each oil company. The series presented covers the period from the inception of the Washington gasoline tax, which has changed as shown in Table 2.

In order to use the gasoline-tax series, it was first necessary to convert the tax to gallons before calendar adjustment

TABLE 2

GASOLINE TAX IN WASHINGTON

Dates	Amt. of Tax per Gal. (In Cents)
State tax:	
July 1, 1921, to Dec. 31, 1923	$0.01
Jan. 1, 1923, to June 30, 1929	.02*
July 1, 1929, to March 31, 1931	.03*
April 1, 1931, to present	.05*
Federal tax:	
Jan. 1, 1932, to June 30, 1933	.01
July 1, 1933, to Dec. 31, 1933	.01½
Jan. 1, 1934, to June 30, 1940	.01
July 1, 1940, to present	.01½

* With rebate.

could be made. The conversion to gallons was made by simple division of the tax collections by the tax assessed. Except for the very small proportion of back tax collections included, this gave the gross amount of gallons sold. As the taxes reported are always for the sales of the previous month, proper allowance for this lag of one month was made in adjusting for calendar variation. It should be noted that the reports of the State Treasurer's Office do not take into account adjustments for collections made of delinquent or back taxes; for example, the collections reported for August, 1939, might include a small portion of gasoline taxes due in June, as well as the bulk of those for July. No adjustment is made in sub-

sequent statements for these delayed collections. It is felt that this is not a serious impairment of the series, as ordinarily the penalty for late payment of taxes would be a deterrent to consistent delinquency. The amount of these late payments would be but a small fraction of the whole tax of any given month.

Livestock receipts (cattle, hogs, sheep).—Livestock received at Seattle pass through the Union Stock Yards, thus affording a count of the cattle (including calves), hogs, and sheep. The data on livestock receipts are shown by months from 1919 through 1939 in three separate series. The Seattle series of livestock receipts were obtained through the Commercial Engineer's Office of the Pacific Telephone and Telegraph Company and from the office of the Union Stock Yards. Although these series have the advantage of being measured in physical units and can be said to be uniformly collected, they are heterogeneous series in that they make no distinction between various qualities of livestock; a head of cattle might be top quality or a lower grade. Furthermore, no cognizance is taken in the series of the varying weight of the animals. Nevertheless, these series give a rough idea of the changes in the various kinds of meat passing through the Seattle market and may be used by those interested in making comparisons with cost-of-living indices and prices of other wholesale commodities as well as prices of meat.

Livestock slaughtered (cattle, hogs, sheep).—Through the co-operation of a private meat-packing company, three series of monthly data showing the number of cattle (including calves), hogs, and sheep slaughtered at Tacoma have been obtained beginning with the year 1920. As Tacoma has no union stock yards and is not a livestock market similar to that at Seattle, these series represent actual numbers of animals killed at the packing-plant. Of course, these series are heterogeneous in that they cover several qualities of each of the various species of animals, but this does not destroy their usefulness in showing the movement of these farm and range products into the stream of distribution. These series are not homogeneous with those covering receipts of livestock at Seattle and cannot be used for comparison except in a general way. The Tacoma series represent activity in the meat-packing business in the Tacoma district, as the data are compiled by the one large packing company in that district. The Seattle series reflect a combination of trading and manufacturing activity because not all of the Seattle receipts necessarily go into Seattle packing-plants and slaughter-houses. Some of the livestock may be distributed to other areas.

New-car registrations.—The demand for new automobiles, trucks, and busses is an active indicator of the purchasing power of individuals and of business establishments. As a measure of business activity, new-car registrations reflect the changing purchasing power of individuals who increase purchases when they can afford to assume the contracts for new cars. When business improves and new equipment can be added or replacements made, purchases of passenger cars and trucks increase. When new businesses are being established due to better times, greater confidence in the prospect for profits increases the retail automobile business. Many other factors are involved in the fluctuations of new-car registrations, such as fear of shortage, price rises, increased taxes, rumors of oversupply, and the addition of new improvements on cars.

In the new-car registrations series pre-

sented, the data combine all kinds and types of new automobiles, trucks, and busses, since in some counties of the Puget Sound Area, such as Island or San Juan counties, there are times when the only vehicles sold are for business uses. The relationship between new registrations of passenger cars and all other types of automobiles in the Puget Sound Area runs about five to one, while for the state as a whole it is approximately four to one. In compiling the series presented in this study, use was made of confidential monthly reports in the offices of the Motor List, Inc., which company is represented in each of the thirty-nine counties of the state by agents whose duty it is to report the make, motor and serial numbers, type of car, license number, purchaser, and vendor of all newly registered automobiles. The data covering the fifteen counties comprising the Puget Sound Area were combined in one series which commences in May, 1926.

During the first ten years of the new-car registration series, automobile manufacturers brought out their new models shortly before January 1. During most of those same years, the state of Washington personal property tax was assessed on March 1. These two facts tended to make for low registrations about November 1, to keep many buyers from purchasing cars during the months of January and February, and to make March an unusually high registration month. For the last three years, manufacturers have brought out their new models during the months of September and October, a fact which has increased the sales during the last three months of the year so that in some cases the late fall sales are nearly equal to the spring sales.[6] Also, the tax law has been changed so that the personal tax is combined with the license fee, and this has materially affected the sales in the spring, so that the months of March, April, and May are about equal in sales volume. Because of these important shifts in the purchasing of new cars, a changing seasonal index-number series was computed.

Newspaper advertising lineage.—Two monthly series were obtained through the aid of the advertising departments of metropolitan daily newspapers. The Seattle series, obtained from Media Records through the *Seattle Times*, dates from 1925, while the Tacoma series, obtained from Media Records through the *Tacoma Ledger*, dates from 1928. Media Records is an agency specializing in newspaper advertising statistics which are collected from the various newspapers throughout the United States. The Seattle series combines into an aggregate the newspaper advertising lineage of the *Seattle Times*, the *Seattle Post-Intelligencer*, and the *Seattle Star;* the Tacoma series combines advertising in the *Tacoma Daily Ledger* and the *Tacoma News Tribune*. Newspaper lineage is measured in agate lines and excludes any self-advertising. Advertising in such a section of the Sunday paper as the *American Magazine*, issued by the *Seattle Post-Intelligencer* and other so-called "Hearst" papers, is included in the present series because it seems as important and as legitimate an inclusion as the national advertising shown in any of the daily papers. At any rate, it is not of sufficient magnitude in the aggregate to affect the combined advertising lineage greatly. Newspaper lineage in the Seattle papers in 1939 was about twice the amount of lineage in the Tacoma papers.

Postal receipts.—Through the co-operation of the local postal authorities, it is

[6] Letter from J. F. Stenstrom, car distributor, Anderson Buick Co., Seattle, Washington, April 16, 1940.

possible to present sixteen series of monthly data representing the postal receipts of the principal cities of the Puget Sound Area.[7] In a number of instances it was necessary to compile the statistics directly from the post-office records. There is considerable variation in the length of the postal receipts series. Beginning dates of the series range from 1919 down to 1932. In at least one post office it was impossible to obtain the monthly postal receipts prior to 1932. For 1939 the total postal receipts of the sixteen cities was $5,736,419. Of this amount the cities of Seattle, Tacoma, Bellingham, and Everett accounted for $4,845,403, or 84 per cent. In this study a composite of these four cities has been considered an adequate sample of the postal receipts of the entire area. Such a composite was used in the index numbers of "Trade and General Business Activity" as described in chapter iii.

As a guide or indicator of business it is evident from study of the various local series that they do not reflect changes in conditions equally well, for in some instances even such a great fluctuation as the 1929–35 depression did not change the postal receipts to any marked extent. In the larger cities the postal receipts change with business, but naturally, the smaller the city, the more it is affected by local happenings. It is possible to tell, for instance, what month the Pacific fleet anchored in the harbor at Port Angeles, and likewise the biennial convening of the state legislature causes an expansion in the postal receipts of Olympia.

Postal receipts, according to Carmichael, are considered unreliable as a business indicator because of one or more of the following reasons: (1) frequency of changes in postal rates makes it impossible to measure the effects statistically; (2) the amplitude of irregular fluctuations is wide in comparison with that of the cyclical change; (3) the response to business changes is sluggish; and (4) the series reacts to developments that are nonbusiness in character.[8]

Postal receipts have the advantage, on the other hand, of reflecting to a degree the activity of the people, business concerns, government departments, and organizations not conducted for profit. In one way its coverage is similar to that of bank debits in the financial field; it is a service that is used universally by people in all walks of life. Except for the brief periods in the months of changes in postage rates, and for a short time thereafter while people are becoming accustomed to the change, the use of the post-office services reflects the general activity of business in the community. Although it is not possible to adjust these series accurately for rate changes, changes in rates are not so frequent as to render the series useless. In the smaller communities very few series can be obtained to show how business conditions are fluctuating. Postal receipts, while not one of the best measures, can be used in connection with others, such as bank debits and building permits, as an additional "straw in the wind."

In the composite index the series of Seattle, Bellingham, and Everett begin in 1922 with that of Tacoma, but in computing seasonal index numbers the first three series go back to 1919 and that for Tacoma to 1921.

Telephones in service.—Two series are presented showing the telephones in serv-

[7] These cities are: Aberdeen, Anacortes, Auburn, Bellingham, Bremerton, Centralia, Chehalis, Enumclaw, Everett, Hoquiam, Mount Vernon, Olympia, Port Angeles, Raymond, Seattle, and Tacoma.

[8] F. L. Carmichael, on "Postal Receipts," in symposium of seven speakers, "The Reliability of Various Statistical Series as City and Regional Business Indexes," *Journal of the American Statistical Association*, XXIX, No. 185A (March, 1934), 92–93.

ice in the Puget Sound Area and also in the entire state of Washington. Statistics of telephones in service were compiled from the monthly reports of the Pacific Telephone and Telegraph Company and cover seventeen cities in the Area.[9] It will be noted that Everett, Mount Vernon, and Anacortes, lying between Seattle and Bellingham, are not included. These cities are served by the West Coast Telephone Company of Everett.

While the series begins with 1920, the Port Angeles stations came into the system in April, 1923. By interpolating between the annual data provided by the telephone company, the series has been extended back to January, 1920, for Port Angeles. At the end of December, 1939, there were 190,974 telephones in use in the Pacific Telephone and Telegraph Company system in the fifteen counties of the Puget Sound Area, while the total in the system for the state of Washington was 264,211—that is, 72.3 per cent were in the Area concerned in this study.

The series of telephones in service is rather sluggish in its movement and thus does not indicate the abrupt changes taking place in business. When business is good and purchasing power increasing, people who might otherwise go without this important convenience have a telephone installed. Many people who must make a choice prefer to do without a telephone but continue to drive a used car. In the more prosperous periods an increase in extension telephones is found. As times become depressed, telephones are removed from homes and apartments and extensions come out. The telephone is usually not removed from a place of business until the business is wound up.

[9] These cities are: Aberdeen, Auburn, Bellingham, Bremerton, Centralia, Chehalis, Enumclaw, Hoquiam, Kent, Olympia, Port Angeles, Raymond, Renton, Seattle, Shelton, South Bend, and Tacoma.

Telephone long-distance calls.—Among the various types of telephone statistics, one that appears to give more prompt indication of business activity than simply telephones in service is that of long-distance calls. Such a series, covering the business of the Everett district of the West Coast Telephone Company, was provided by the general manager of the company. The district covered is principally along Puget Sound between Seattle and Bellingham and includes such towns and cities as Everett, Mount Vernon, Anacortes, Snohomish, Sedro-Woolley, and Monroe. The Everett district lies in Snohomish and Skagit counties and thus is a rather restricted section of the Puget Sound Area. As the population of the Everett district is between 5 and 10 per cent of the population of the Puget Sound Area, this telephone series is not a satisfactory measure of business activity for the Area. However, it is a valuable index of business activity for the district it represents, and it is so used by the telephone company. As of October, 1939, there were 17,100 telephones in the Everett district. The series began with January, 1929, ended in October, 1939, and consists of the number of messages per station. This statistical unit has the advantage of uniformity and allows for fluctuations in the number of stations from month to month.

Wheat receipts.—The carload receipts of wheat at Seattle and at Tacoma are presented in two separate monthly series. These data were obtained from the daily reports of the Seattle Grain Exchange and date from January, 1919, shortly after the close of hostilities in World War I. It will be noted that these wheat receipts series commence over a year and a half before it was possible to get regular published prices of wheat at Seattle ow-

ing to the post-war adjustments of food control.

Although the Puget Sound Area does not produce the wheat that passes through its major ports and into consumption via its milling industry, wheat receipts data convey some idea of the amount of wheat shipped into the Area for consumption and exportation.

C. TRANSPORTATION AND SHIPPING

Carloadings.—The series of carloadings data presented in this study represents the number of cars loaded each month from 1924 through 1939 in the territory of the Pacific Northwest Advisory Board. The Pacific Northwest Advisory Board is advisory to the Association of American Railroads, Operations, and Maintenance Department, Car Service Division. The territory for which it collects carloadings statistics is comprised of the entire state of Washington, all of Oregon except two southeastern counties and Klamath Falls, ten counties in northern Idaho north of the Salmon River, and territory west of a line north and south through Paradise, Montana. The carloadings data were compiled from monthly reports in the offices of the Advisory Board.

While the total of cars loaded is presented here, it is interesting to note that the total is composed of seven specific and one miscellaneous series in proportions listed in Table 3, based on total carloadings for the years 1935–37 average = 100 per cent.

A carloadings series such as this one gives an idea of the volume of railroad freight traffic originating in the Pacific Advisory Board Area, of which the Puget Sound Area is a fractional part. This particular series would perhaps be more useful in compiling an index of business for the state of Washington or the state of Oregon or for the Pacific Northwest than an index of a small area such as the one delimited in this study. However, since logs and forest products comprise almost half of the carloadings, and the lumber industry is so very important to the welfare of the Puget Sound Area, the index does give an auxiliary measure of activity in the lumber industry as it pertains to rail shipments.

There are certain limitations on a carloadings series as an indicator of business activity. One of these is the great competition from water traffic in such a water-

TABLE 3

PERCENTAGE OF CARLOADINGS ORIGINATING IN THE PACIFIC NORTHWEST ADVISORY BOARD AREA

Product	Percentage of Carloadings
Livestock	1.5
Ore	1.5
Coal	2.9
Fruit	4.9
Grain and its products	6.9
Logs	21.6
Forest products	25.6
Other	35.1
Total	100.0

bounded area as that of northwestern Washington. Logs and piling may be rafted and towed or shipped by water, and canned salmon is shipped to domestic ports in California and eastern United States by water. A large amount of merchandise is shipped by truck. Another limitation on carloadings is that the use of the statistical unit "carload" is open to criticism because a "carload" may be a car loaded with anywhere from five to upward of sixty tons of freight, depending on the commodity. Wheat cars are loaded with from thirty to sixty tons. Each commodity carries a minimum tonnage which is necessary in order for the shipper to obtain the carload rate. As there is such a variation between the sizes of these

minimum loads and also the size of freight cars used, the figures of "carloadings" are in no way uniform. Also, there are naturally great variations in the values of the commodities carried, although carloadings are expressed as units of loaded cars regardless of value.

Many carloads of merchandise originating at the ports of Washington and Oregon may be simply merchandise in transit through these ports from another country. To this extent the carloadings data are weakened as a measure of local business activity, if one thinks of business activity as the extraction of raw materials and manufacturing processes alone. The broader use of the term "business activity" would include any and all business transactions involving raw materials, semimanufactured and finished products, wholesale and retail distribution, and the purchase and sale of all kinds of services. Merchandise coming through a port would make business for the steamship, railroad, and trucking companies; longshoremen, insurance brokers, custom-house brokers; banks and telegraph companies; and wharfage, warehouse, and storage companies, to mention a few. Unfortunately, it is not possible as yet to obtain tonnage statistics of shipments by truck except for bulk petroleum, and that is only for the year 1938.[10] No oil traffic originates in Washington.

Egg shipments.—The carloads of eggs shipped from the Puget Sound Area are shown from 1926 to date in a monthly series which was obtained from the Department of Agriculture. These statistics are reported in the *Dairy and Poultry Market Statistics Annual Summary*, of the Bureau of Agricultural Economics, United States Department of Agriculture, and current statistics are reported monthly by principal points of origin for the state of Washington in the *Federal-State Market News Service* issued by the Agricultural Marketing Service at San Francisco. All the egg shipments reported in December, 1939, were from seven points on the west side of the Cascade Mountains and all these are in the Puget Sound Area.

Egg shipments rose from 1,346 carloads in 1926 to a peak of 2,354 carloads in 1931 but have declined 884 carloads for the year 1939 and 781 for the year 1940. Carlot shippers in the Puget Sound Area pack six hundred cases of thirty dozen eggs per case to the car. The bulk of these eggs go to the state of New York. In 1940 carlot shipments to New York totaled 597, with 67 to New Jersey, 36 to California, 23 to Pennsylvania, 20 to Washington, D.C., and the balance to sixteen other states.

As stated above, almost all the eggs shipped from Washington are from the Puget Sound Area. Table 4 lists the carload shipments in the peak year of 1931 and in the low year of 1940 from the egg-shipping points of the Puget Sound Area. Egg shipments from the Puget Sound Area declined 66 per cent from 1931 to 1940.

Egg shipments is a series which gives a helpful idea of the condition of the poultry market in the Puget Sound Area, for it shows the surplus in this branch of farm products available for domestic shipment. It serves both as a measure of transportation activity and more largely as a measure of agricultural conditions as they pertain to the specialized poultry industry of the Area. In 1935 eggs shipped were valued at about one-tenth of the value of agricultural products in the Puget Sound Area and about one-

[10] Washington State Department of Public Service, Accounting and Research Sections, "A Study of the Cost of Transporting Bulk Petroleum by Motor Carriers" (Olympia, 1939), pp. 1–8. (Mimeographed.)

fortieth of the value of agricultural production of the state. It would thus appear that as a measure of agricultural activity this one series is not strong.

Exports to Alaska—value.—Exports to Alaska from the Port of Seattle are shown in dollar values by months from 1920 until August, 1939, when the United States Treasury Department ordered dis-

TABLE 4*

EGG SHIPMENTS FROM WASHINGTON IN CARLOADS, 1931 AND 1940

Shipping Point	1931	1940
Aberdeen	45	.....
Bellingham	301	120
Centralia	54	.....
Chehalis	55	.....
Everett	226	72
Kent	33	.....
Lynden	175	97
Mount Vernon	113	30
National	.....	1
Olympia	14	.....
Seattle	764	202
Tacoma	309	164
Winlock	182	84
Total for Puget Sound Area	2,271	770
Balance of Washington	383	11
Total for Washington	2,654	781

* Source: Agricultural Market Service, San Francisco, *Federal-State Market News Service*, summaries for 1930–40.

continuance of the dissemination of statistics on imports and exports through local ports.[11] While the principal imports from Alaska are canned salmon and all forms of fish products, gold bullion, and ore concentrates, the exports to Alaska can be said to consist of "merchandise," which means food, clothing, canning and mining equipment, and various supplies. The Alaskan export business has increased from $28,398,000 in 1929 to $39,481,200 in 1938, an increase of 39 per cent.

Commencing with the month of April, 1939, the export statistics are estimated by the Port Warden's Office of Seattle because, "owing to regulations recently enacted by the U.S. Customs Service, export declarations covering shipments to Alaska must be forwarded to New York for compilation, necessitating a delay of one month in the publishing of same by the Port Warden's Report."[12]

In the May, 1939, issue of the *Port Warden's Report of Waterborne Commerce* it was stated: "Another change by the U.S. Customs Service in the regulations governing shipments to Alaska makes it impossible to publish detailed data until the end of the calendar year. The volume and value will be estimated each month and the corrections made upon receipt of the necessary information."[13] Thus once more the difficulties of obtaining worth-

[11] Mimeographed letter from the Harbor Department, City of Seattle, January 25, 1940, over the signature of Paul L. Sweeney, acting port warden, stated: "In September, 1939, the U.S. Treasury Department issued a regulation (T.D. 49970) prohibiting publication of information concerning cargoes carried by any ships entering or leaving American ports, as a result of the war in Europe. It has therefore become necessary for the Harbor Department to suspend publication of the Port Warden's Report of Waterborne Commerce until such time as this order is modified or rescinded by the U.S. Treasury Department." Every effort was taken by the port warden's department and the chamber of commerce of Seattle to point out the importance of the statistical data which this regulation suspended, but permission could not be obtained to collect the information from the ship manifests for future publication when the regulation should be rescinded. The action of the Treasury Department has thus suspended, or perhaps stopped permanently, the publication of monthly series covering imports and exports of foreign and domestic commerce in tonnage and values which were begun twenty years ago. It is therefore impossible, since August, 1939, to know what or how much merchandise has passed inbound or outbound through the Port of Seattle each month.

[12] City of Seattle Harbor Department, *Port Warden's Report of Waterborne Commerce* (Seattle, April, 1939), p. 6.

[13] *Ibid.*, May, 1939, p. 6.

while statistical data, published for so many years in monthly bulletins, were increased, presaging the final order which ended in complete suspension of such information. It is interesting to observe a statement made by E. G. Mears, in a very enlightening article pointing out the weaknesses of United States foreign trade statistics, to the effect that "a period of national uncertainty is precisely the time when it is uneconomical and unwise to curtail research and statistics."[14]

Exports and imports—total tonnage.—As measures of shipping activity two monthly series are presented showing the total exports and imports in tonnage through Seattle and Tacoma. The Seattle series begins with 1919 and the Tacoma series with 1928. These statistics were compiled from the monthly reports of the port wardens of the two cities, which reports were ordered stopped by the United States Treasury Department in T.D. 49970, effective September 27, 1939.

Water transportation has played a considerable role in the upbuilding of Seattle and Tacoma and, for that matter, of the Puget Sound Area. The shipping of logs, piling, and lumber from the heavily wooded areas has been an important contribution to the economic welfare of this region. Seattle and Tacoma are the nearest large American ports to Alaska and to the Orient. Most of the canned fish from Alaska comes to Seattle, and these Puget Sound ports are the principal supply and outfitting stations for Alaskan canneries and cities. The decline in shipping has been seriously felt in the Area, which at one time controlled the bulk of the American silk-importation business of Japan. Tonnage of imports and exports combined through the Port of Seattle has declined from 9,167,000 tons in 1929 to 5,856,600 tons in 1938, a drop of 36.1 per cent. The loss of tonnage through Tacoma was even more severe, as it fell from 6,400,200 tons in 1929 to 2,066,400 tons in 1938, a decline of 67.7 per cent. To answer a natural question as to the kind of business lost, Table 5 will help.

Exports and imports—total value.—As a further description of transportation by water through the ports of Seattle and Tacoma, two monthly series are shown of total exports and imports in dollar values. The Seattle series begins with 1919 and the Tacoma series with 1938. These series ended in 1939 with other export and import series, owing to the previously mentioned Teasury Department order. The decline in the dollar values of foreign and domestic water-borne commerce through Seattle was greater in per cent than the tonnage decline. In the year 1938 the combined goods moved were valued at $343,743,600 as compared with $771,174,300 in 1929. This is a decrease of 55.4 per cent. The change in value of all water-borne commerce, both foreign and domestic, through the Port of Tacoma was less than that of Seattle, for it went down from $186,820,700 in 1929 to $101,101,900 in 1938, a decline of 45.9 per cent. Again, it is interesting to see the kind of business lost over the decade ending in 1938. Table 6 shows the chang-

TABLE 5

PERCENTAGE LOSS OF WATER-BORNE COMMERCE IN TONNAGE, 1929–38

Type of Shipment	Seattle	Tacoma
Domestic imports	38.3	76.2
Domestic exports	23.6	58.4
Foreign imports	44.9	34.0
Foreign exports	41.0	65.4

[14] "The Foreign Trade Statistics of the United States," *Journal of the American Statistical Association*, XXX, No. 191 (September, 1935), 514.

es in value of shipments passing through the ports of Seattle and Tacoma.

In order to have series representing transportation and shipping of water-borne commerce which are continuous and do not stop with the government order of September, 1939, recourse was had to series of imports and exports for the Washington Customs District. These statistics are for foreign commerce only and are to be had in dollar values but not in tonnage.

Exports—value (Washington Customs District).—The foreign exports from the Washington Customs District are shown

TABLE 6

PERCENTAGE LOSS OF WATER-BORNE COMMERCE IN VALUE, 1929–38

Type of Shipment	Seattle	Tacoma
Domestic imports.....	36.6	53.1
Domestic exports.....	44.7	38.2
Foreign imports.....	87.3	22.2
Foreign exports.....	53.8	55.4

in this series, which is continuous by months from 1920 through 1939. Again, a very noticeable decrease is shown in foreign commerce, the drop from $153,874,236 in 1929 to $78,334,630 in 1939 being approximately 49 per cent.[15] By way of comparison, the combined foreign exports of Seattle and Tacoma dropped in value from $111,972,925 in 1929 to $50,910,750 in 1938, the last full year of record—a decline of 54.5 per cent.

Export statistics as well as those of imports when used as measures of business activity are surrounded with considerable danger because of the deficiencies in the manner of their reporting. Exports are credited to the port of final departure regardless of the place where the ship or freight car was loaded. Thus a ship loaded at Seattle which touches at San Francisco before departure to Australia is said to "clear" from San Francisco, and the whole shipload of exports would be credited to the San Francisco district instead of the true district of origination. This means that when Seattle or any port in the Washington Customs District acts as a point of final departure for export shipments the Washington Customs District gets credit for the exportation. The official statistics of exports, like the statistics of imports, do not tell a true story of the foreign trade of any particular customs district. It is necessary to take into account the entire United States in order to get the correct picture of foreign trade from government statistics. It is likewise impossible to make valid comparisons of foreign trade statistics between any of the customs districts of the United States.

Imports—value (Washington Customs District).—The series of value of imports covers those imports going into "consumption" only, that is, those goods which are entered for payment of duty at the ports of entry. This excludes all merchandise entering the district on immediate transportation entries, that is, for transportation to interior ports of entry for appraisement and payment of duty, and all merchandise entered on warehouse entries for storage, manufacture, or re-export. It is thus seen that the series is but a portion of the goods coming into the district, but it does represent those which apparently are for use in the Area. This monthly series of imports was obtained through the Seattle office of the Bureau of the Census and dates from 1920. The Washington Customs District includes all the state of Washington except several counties along the north bank of the Columbia River, in-

[15] The 1938 value of exports was $69,065,296—a decline of 55 per cent from the 1929 value. Exports amounted to $87,339,053 in 1940.

cluding the principal cities of southern Washington, namely, Vancouver and Longview. While this district is much larger than the Puget Sound Area, it coincides with it as to seacoast boundaries and principal seaports.

The tremendous deflating effect of the depression period commencing with 1929 on the water-borne commerce of Washington is shown by comparison of the $216,774,021 value of foreign imports (for consumption) of 1929 with the $34,467,535 value in 1939, a decline of approximately 64.1 per cent.[16] Against this the combined value of foreign imports of all kinds, consumption, warehouse, immediate transportation, and otherwise, through Seattle and Tacoma in 1929 amounted to $263,173,933, and in 1938, the last full year of record, $51,205,413—a decline of 80.5 per cent.

Ship departures to Alaska.—As an indicator of business with the Territory of Alaska, for which Seattle is the principal supply center and receiving port in the United States, a monthly series dating from June, 1922, presents the departures of Alaska-bound ships. The series of ship departures to Alaska was compiled from the *Port Warden's Report of Waterborne Commerce* and covers only ships leaving Seattle. While it is true that such a series cannot be depended upon as a short-range indicator of business, it does show whether shipping through this port is increasing or falling off. These records are for passenger and freight vessels, some of which sail at regular intervals regardless of business activity in the Puget Sound Area, whereas others depart at irregular intervals. Ship departures are not constant throughout the year and have a marked seasonal variation—high in the months from April to August, and low from August to April. There has been no change in the size of ships during the period covered by the data to affect the unit of measurement. Like other series reported by the Seattle Port Warden, this series was discontinued in August, 1939.

Seattle Transit System passengers.—A monthly indicator of the business activity of the Seattle Transit System of the city of Seattle, from 1920 through 1939, is shown by the number of passengers carried. Although the city population increased about 50,000 from 1920 to 1940, the use of automobiles greatly increased during that period, with the result that the use of the transit facilities fell to almost half of what it was twenty years ago. Passengers carried by the street transit system is but one indicator of consumer well-being. This series may reflect changes in employment and is associated with changes in population. The series cannot be adequately corrected for automobile competition, which nevertheless seriously affects it. Within the last few years the Seattle Street Transit System has discarded streetcars and installed trackless trollies and motor coaches. The extension of lines following this move should increase the business of the company. As automobiles increase in number and parking space is reduced in downtown city streets, automobile competition with the street transit system might actually decline or at least increase at a greatly retarded rate.

Tourists—Mount Rainier National Park.—A monthly series dating from 1919 showing the number of tourists visiting Mount Rainier National Park was obtained directly from the United States Department of the Interior's National Park Service. The number of tourists visiting Mount Rainier National Park is

[16] The 1938 value was $29,256,285—a decline of 86.5 per cent from the 1929 value. The 1940 value was $41,949,153.

an indicator of the changes in the volume of tourist business for the state as a whole but particularly for the Puget Sound Area, in which the park is located. This series has a strong summer upswing, when tourist travel is heaviest. It is of little value for measuring activity except for months in the middle of the year when visitors are principally attracted to the park.

D. FINANCIAL

Bank debits.—Bank-debits series by months were obtained through the Division of Research, Federal Reserve Bank of San Francisco, for the four principal cities in the Puget Sound Area, namely, Seattle, Tacoma, Bellingham, and Everett. The Seattle and Tacoma series commence with 1920; the Bellingham series with February, 1922; and the Everett series with June, 1924. A high percentage of all payments in the United States is made by check. This percentage has been estimated as high as 90 per cent for the United States. Whether or not this would be characteristic of the Puget Sound Area is not known, but no reason is evident that it should be at great variance with other parts of the country. This impression of wide usage of check payments, together with the fact that bank debits are promptly obtainable, has led to the use of bank-debit series as indicators of general business conditions and business activity. Any one economic series used by itself is in grave danger of being incorrect in its measurement of the current condition of business, and it would be reckless to rely upon the use of but one series to the exclusion of all others.

One source of weakness of the bank-debits series lies in the fact that they are expressed in dollars and cents and thus may reflect principally changes in price. Unless the bank-debits series have been deflated by use of some purchasing-power index, they may not clearly reflect changes in business activity. As a practical matter, adjustments for changes in the purchasing power of the dollar are often recognized but not made.[17]

Bank-debits series may be criticized because they may give a false impression of business activity due to the fact that payments are sometimes made ahead of or long after the business activity from which the payment originated, thus causing a discrepancy in the timing of events. In a relatively small area of the country the lead and lag of payments may not offset each other as well as they might for the country as a whole.

It is true, moreover, that within any area there may be duplications in bank debits arising out of the repeated turnover of the same products or goods for which payment is made by check. However, when it is considered in the light of the large bulk of check payments, such duplication does not loom up as a very serious limitation on the use of the data.

Regardless of their admitted weaknesses and disadvantages, bank-debits series are as widely used by various agencies for assisting in pointing the way and expressing the general business activity as any economic data we have. Bank debits have one great advantage in that they have wide coverage, reaching into

[17] F. E. Richter, of the American Telephone and Telegraph Co., stated: "In the case of bank debits, we have ceased in recent years to use any price corrector at all. I hope that persons who have worked with debits in these days of universal stock speculation will agree with me that the probable error in calculating the trend is fully as great as, if not greater than, the probable error involved in not trying to correct the series for commodity, security, and other 'price' changes" ("The Bell System Regional Business Indexes," *Journal of the American Statistical Association*, XXIV, No. 165A [March, 1929], 156–60).

varied fields of business and nonbusiness activities from which other general statistics are unavailable. For this reason they seem to give, from a logical standpoint, at any rate, adequate indication of general business activity. As stated before, they should not be used alone, but with other series as indicators of the business movement.

In the Puget Sound Area, where it is difficult, if not impossible, to obtain sufficient data covering such a large part of the economy as agricultural activity, bank debits in a measure fill the need because they cover agriculture as well as manufacturing, trading, shipping, and financial transactions. Furthermore, in the Puget Sound Area, where production series desirable for the measurement of business activity are relatively scarce, or too short in duration, bank debits are necessarily important as an indicator.

Bank deposits—Seattle.—A further view of the financial situation of the Area is to be had through study of the two monthly series of bank deposits presented. These series of total deposits for Seattle and demand bank deposits for Seattle were compiled from the monthly report of the Seattle Clearing House from 1923 to date. Total bank deposits in Seattle dropped in 1932–33 to the 1925–26 level, but by 1936 they went well above the 1929 peak and by the end of 1940 were double the deposits at the end of 1929. In recent years the steady increase in bank deposits can be largely attributed to several main causes: (1) increase in government borrowing from the banks; (2) increase in saving by business concerns and individuals due to lack of confidence in business to make profits or reluctance to risk funds in business expansion and investments; and (3) increase in buying on credit instead of for cash. These and other factors have changed the relationship of bank deposits to business activity and doubtless have weakened these series as measures.

Business failures.—Only one series relating to business failures is presented, that of numbers of business failures in the Puget Sound Area. A second series covering liabilities of business failures was obtained, but the data were found to be so erratic that the series was abandoned. The monthly series of the number of failures was compiled from original records in the office of Dun and Bradstreet in Seattle and goes back only to 1932. It was possible from the locations of the various discontinued companies to eliminate those not definitely in the fifteen counties of the Puget Sound Area. The number of business failures includes establishments of all sizes, but this series has a regularity which is not found in the series of liabilities. In a series of liabilities of business failures the inclusion of a few unusually large items with the many small ones makes it extremely difficult to obtain reliable measures of seasonal variations. This is especially true when the period of the data is short and when the area covered by the data is comparatively small. The series presented is homogeneous from the standpoint of cities included, but it is too short to give a reliable indication of the seasonal movement.

Number of business failures is a series which does not respond quickly to changes in business activity; there is a time lag between a change in activity and the number of failures. A business though weakened by a period of depression may not actually fail until just before or shortly after business in general has made a turn toward recovery and prosperity. Failures do not generally happen at the

time when the conditions causing them are in clearest evidence. Furthermore, failure statistics do not include businesses which fail for other than financial reasons, close voluntarily, and settle their obligations without loss to creditors. Such discontinuances of business help to reflect business conditions and should be included in the number of discontinued businesses. Another weakness of number of failures is that it does not give an accurate measure of the seriousness of the failures, the size of the organizations discontinuing business being ignored.[18]

Life insurance sales.—Life insurance statistics in the state of Washington are available only on an annual basis through the State Department of Insurance; however, it was possible to obtain a monthly series of new paid-for ordinary-life insurance in Washington through the co-operation of the Life Insurance Sales Research Bureau of Hartford, Connecticut.[19] This insurance series was compiled by the Bureau commencing with 1922.

Life insurance data give an indication of the propensity of individuals to protect their dependents and to increase their savings. Business activity, as it relates to the life insurance business in particular, is measured by "ordinary life insurance," which is an important sample type of personal life insurance. Such a series as this one is related to the financial condition of individuals and particularly businessmen because life insurance contracts are a form of savings. As an index of business activity ordinary life insurance is slow in its reaction. When there is an upturn in business and the purchasing power of people increases, it is not immediately reflected in life insurance sales, as people tend to liquidate their old obligations before assuming new long-term contracts. They may spend some time paying off loans on their insurance policies before purchasing new policies. It is natural to consider present needs and desires before entering a life insurance contract which is an obligation extending over many years in the future. Furthermore, an increase in policies sold may be an indication of an insurance drive for business and not of general business activity. A series of life insurance sales measures the trend of business activity as reflected in the purchasing power of the people but does not measure short-term fluctuations with accuracy.

In 1929 the amount of ordinary life insurance sold in Washington was reported as $166,712,000, while in 1940 it had fallen to $90,599,000, a decline of 45.6 per cent over the period.

E. REAL ESTATE AND BUILDING

Building permits.—Eleven series each of numbers of building permits and value of building permits are presented. These data represent the principal cities of the Puget Sound Area where building codes are in force.

In all these instances except Seattle, Tacoma, and Port Angeles, the data were compiled directly from the records in the offices of city engineers and building inspectors.[20] These monthly series vary as

[18] On the weakness of numbers of business failures to measure business activity, J. H. Cover said: "In constructing regional barometers, we are frequently tempted to employ numbers of voluntary business failures, inverted, to present changing conditions. In many localities the peak of failures occurs subsequent to the low point in general business depression due to the efforts of creditors to re-establish solvency" ("The Significance of Regional Business Analysis," *Journal of the American Statistical Association*, XXIV, No. 165A [March, 1929], 152–55).

[19] Does not include data of revivals, increases, dividend additions, annuities, group insurance, and reinsurance from other companies.

[20] The eleven cities are: Aberdeen, Bellingham, Bremerton, Centralia, Chehalis, Everett, Hoquiam, Olympia, Port Angeles, Seattle, and Tacoma.

greatly in the manner of recording the statistics as the building codes themselves vary as to what constitutes a project suitable for the issuance of a building permit. The building codes of the eleven cities are far from uniform, and the smaller cities set up regulations wholly inadequate for use in the larger cities. The longest series obtainable were those for the cities of Seattle and Tacoma which date by months from the year after World War I. These series are obtainable previous to 1919, but it was decided to use only the last twenty years in this study. For the other nine cities the series commence at various dates between 1920 and 1927. In the case of Olympia the number series can be carried back with uniformity only to 1925, while the value series is three years longer. The Port Angeles data go back to 1924 for numbers and to May, 1920, for values.

As a measure of business activity, building permits serve to measure building operations being planned rather than construction actually under way. In thirty-seven eastern states statistics are obtainable on construction contract awards, but Washington is not one of the states where such data may be obtained. In comparing building-permit statistics with contracts awarded as measures of business activity, the purpose for which the data are to be used must be considered. Permits indicate intentions to build, but contract awards are much more definite indications that the work will be accomplished.[21]

Building-permit data ordinarily omit park projects, street construction, and bridges, but cities now attempt to include schools, recreation fieldhouses, and various government buildings. For a region such as the Puget Sound Area even the aggregate of data gathered from the various cities would give but a part of the building that is being done. It is quite evident that much of the building in the past decade has taken place outside urban limits and has not been included in city building-permit statistics.

Considerable construction has taken place in the Puget Sound Area in building a huge airfield and cantonments at Fort Lewis, between Tacoma and Olympia; a naval air station at Sand Point near Seattle; and additional drydocks, buildings, and employees' homes at the Puget Sound Navy Yard, Bremerton. These projects bring work and material orders and increase business in general in the near-by cities. Inclusion of government project statistics in city building construction statistics tends to distort the picture unless allowances are made for them. Such unusual items would have an important effect on the seasonal variation.[22]

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[21] In comparing building-permit statistics with contracts awarded, the *Commercial and Financial Chronicle* (January 30, 1932) leaned toward the former: "We are inclined to think that the building figures which we and a few others undertake to collect, furnish a better indication of the course of new building work than the records of contracts awarded, though it is not to be denied that these latter have a peculiar value of their own. In the first place, building permits deal with distinctively building work, and, in the second place, inasmuch as they represent projected work more largely than work actually begun, they are a much more valuable indication of intentions with respect to the immediate future. When award of a contract has been made, it almost invariably means that work will commence close upon the heels of the award. Not so when a plan is filed for a new building or for building work. Numerous considerations may, and often do, intervene to postpone the actual carrying out of the plans, and in most cases the contract for the work still remains to be awarded at some near or remote date. Thus it is unmistakably true that intentions with respect to new building work are more clearly and more definitely reflected by the building permit figures than by the other figures referred to."

[22] As, e.g., the construction of a social security building at Olympia in March, 1936, which ran the

A question not readily settled is this: Which of the two types of data, numbers or values of building permits, gives the more accurate measure of business activity? In small localized areas or cities the use of numbers is perhaps better, if a choice must be made, for the reason that the permits for important buildings inflate the values of permits, whereas one permit covers the project. On the other hand, large numbers of small jobs and permits for low-cost buildings, repairs, and alterations tend to make permit numbers show an increase in business activity not warranted by the value of the permits or the importance of the construction. There is a wide variation between the actual and the estimated costs of buildings. The tendency to cut the estimate down is encouraged by the application of building-permit fees based upon the estimated cost of the new building or the repairs contemplated. To add to the difficulty of measurement, when increased appropriations or extras are added to the original estimates, there is no provision for these increases to find their way into the building-permit statistics. Value statistics have the added weakness of being subject to the changes in the purchasing power of the construction dollar and theoretically should be deflated for changes in the cost of building materials and labor.[23]

It is a further weakness of these series that long periods of time may occur between the issuance of permits and the commencement of the actual construction work. To the extent of this lag which occurs before work is begun, a building-permit series fails to register the current business activity. Another difficulty is that projects may be abandoned after the permits are issued. Even if not definitely abandoned, the work may be so long delayed that the permit series loses its efficacy as a measure of the volume of construction work.

The total building permits of the eleven cities in the Area for 1939 were reported as $17,932,600, embracing 11,126 permits. Of these, the cities of Seattle, Tacoma, Bellingham, and Everett accounted for $15,038,400 in value and 8,521 in number of permits. These latter figures are in the proportions of 84 per cent of values and 76.5 per cent of numbers. If the Olympia figure is adjusted to the nine-year average in June on account of the extraordinarily large permit value in June, 1939, the percentage would be 88 per cent of the value of all building permits issued.

Real estate transactions.—The activity in real estate is an indication of general business activity, and it has been possible to obtain a number of series for the Area relating to the real estate transactions taking place. Separate series are shown for nine counties in the Puget Sound Area and one series combining the transactions of the nine counties.[24] All the series of real estate transactions are monthly commencing with January, 1930, and were

permit values of that city up to $832,000, whereas the average for March for the previous nine years was only $20,420. This same situation occurred again in June, 1939, when the value of permits was $917,500, and the average of the previous nine Junes only $20,490.

[23] A criticism of value statistics was made by J. H. Cover in the following words: "An important shortcoming of the value series is the necessity of deflation or correction for changes in construction costs. Could we find an adequate index number representing cost of construction, the use of permit values would be more significant. While cost of material and of labor are included in most indexes, other items such as cost of credit are usually overlooked. Labor is more efficient in depressions" ("Building Permits as a Basis for Analyzing Building Activity," *Journal of the American Statistical Association*, XXVII, No. 177A [March, 1932], 126–29).

[24] The nine counties are: Clallam, Grays Harbor, King, Kitsap, Pierce, Skagit, Snohomish, Thurston, and Whatcom.

obtained from data compiled in the offices of the Washington Title Insurance Company, Seattle, which in turn collected them through their representatives at the various county courthouses.

Real estate transactions consist of deeds, mortgages, and contracts. They are reported in number of transactions and not in dollar values and thus have some of the same weaknesses as building-permit numbers as contrasted to the value of building permits. Real estate transactions differ from building-permit data in one important regard which is that real estate transactions are business deals which have been consummated and are not simply planned undertakings which might not go through to completion. It was thought desirable to combine all types of transactions in order to obtain a larger view of real estate activity. The combination of the transactions of the nine counties records a large proportion of the real estate activity of the Area.

Real estate mortgages—value.—The value of real estate mortgages is a monthly series dating from 1930 which presents the varying investment of capital made over the last ten years in real estate mortgages in King County, the most heavily populated county of the Puget Sound Area and of the state of Washington. These data were obtained from the legal department of the Washington Title Insurance Company, Seattle.

Real estate foreclosures—number.—Another series of real estate activity is the number of foreclosures in King County. An idea of the financial stress under which owners of real estate have found themselves during the last nine years is shown by the number of real estate foreclosures. These monthly statistics were obtained from the same source as the previous real estate series.

As indices of business activity real estate transactions are not important from the standpoint of short-term reactions. They give a better measure of the trend of investments of longer duration. As business conditions change, there is a change in the attitude of people toward various types of investment. Real estate investment is an alternative to the purchase of securities, insurance, commodities, or simply leaving money in the bank. In recent years the government has fostered the home-building movement through loans with relatively easy terms. Real estate transactions show the activity in this connection not only in the urban communities but in the suburban districts as well. Real estate transactions may be a reflection of an increase in population, of land speculation, or investment for building purposes. There has been no land boom in the Pacific Northwest since World War I, and the increase in population in the Puget Sound Area has not been great; it would seem, therefore, that the principal movement in real estate has been due to the desire to acquire real estate as a long-term investment.

F. PRICES AND COST OF LIVING

Cost-of-living statistics.—Seattle cost-of-living statistics are available in index-number form from March, 1923. The series published quarterly by the Cost of Living Division of the Bureau of Labor Statistics shows the cost of goods purchased by wage-earners and lower-salaried workers in Seattle, using an average of 1923–25 as equal to 100 per cent. This series has been converted to the base 1935–37 average = 100 per cent in order to conform to all other index-number series presented.

The cost-of-living series includes food, clothing, rent, fuel, light, house-furnishing goods, and miscellaneous items in-

cluded in the standardized budget for wage-earners and lower-salaried workers set up by the Bureau of Labor Statistics.

According to these data, the cost of living in Seattle reached its peak in December, 1925, and not in the year 1929, as many suppose. The low point came in June, 1933, according to the index series which was reported at that time but twice each year. The high point was 120.9 and the low point 92.1 on the average. From June, 1933, the index mounted to 104.6 in September, 1937, and then rose slightly to 105.8 as of December 15, 1939.

Food prices.—As a matter of interest to businessmen or others concerned with questions of purchasing power and prices, this index-number series of food prices, issued by the Cost of Living Division of the Bureau of Labor Statistics, is presented. Food prices in Seattle are now published quarterly along with similar data of thirty-one other cities and represent the types of food purchased by wage-earners and lower-salaried workers. The index series as published uses an average of 1923–25 as equal to 100 per cent, but this has been converted to an average of 1935–37 = 100 per cent in order to conform to the base used in all the other series presented in this study.

A food-price index series has the limitation that it is affected by the changes in the purchasing power of the dollar. Allowance for this influence would require deflation of the series by an index measuring changes in the "food dollar" appropriate to the area for which the food prices were collected. A further limitation on the food-price index is that it refers to one particular food budget, that of wage-earners and lower-salaried workers. While this limitation is a necessary one, it nevertheless circumscribes the usefulness of the index.

The food price index reached a low of 80.0 in the last half of 1932 according to the semiannual report of December, 1932, having dropped from a peak of 132.3 in December, 1925. From 1932 the index of prices increased to a high of 108.7 on March 15, 1937, and dropped to 94.9 in December, 1939. There was practically no net change during 1938 and 1939.

The index numbers of food prices are not considered a valid index of business conditions, because prices may go up or down in any phase of the business cycle for reasons not connected with business activity. The passage of certain types of legislation affecting agriculture or unusual climatic conditions might influence food prices out of all proportion to the changes taking place in business conditions.

Livestock prices—cattle, hogs, sheep.—Series of price quotations of livestock such as cattle, hogs, and sheep presented here are not intended as indicators of business activity but are meant to show in some degree the effects of changes in economic activity as they relate to certain groups supplying or demanding these commodities. It should be interesting to executives concerned with the sale or purchase of these or related commodities to see how the prices to producers have varied through the years of prosperity and depression. Also, these series give indication of the spread of wholesale prices which should be helpful in checking market spreads in retail prices. All these prices are quotations at Seattle compiled from the daily newspapers. In taking off these series, the price first quoted in the month was used. The prices were obtained wherever possible from the *Seattle Post-Intelligencer*, the morning newspaper, but on at least one occasion when publication was suspended by a strike for 107 days, from August 14

to November 29, 1936, the prices were taken from the *Seattle Times*, an evening paper.

The cattle-price series, which commences with 1920, is the "dollars per 100 pounds" quotations for "prime steers" at the Seattle Union Stock Yards. "Prime steers" and "choice steers" were used as synonymous terms in compiling this series of prices.

The hogs series, commencing with 1920, is the "dollars per 100 pounds" quotations for "prime lights" at the Seattle Union Stock Yards. "Prime lights" vary from 150–210 pounds to 180–210 pounds. For a short time this was from 100 to 200 pounds. "Prime lights" was used as synonymous with "good to choice," which appears to be the same in the quotations.

The sheep series, commencing in June, 1920, represents the prices of "choice lambs" in dollars per hundred pounds at the Seattle Union Stock Yards. There appears to be no confusion in terms throughout this series, although undoubtedly there was some variation from time to time in the meaning of the words "choice lambs." There were no quotations to be had for July and August, 1924.

Produce prices—eggs, milk, poultry.—Price series of eggs, milk, and poultry were obtained from the daily newspapers with the exception of the milk series. In the series of egg prices dating from 1921, the price per dozen represents bids to producers for "standards." "Standards" are not the largest and best eggs but are of second size. It was found that "extras" ran about two cents per dozen higher than "standards" from 1929 on. In compiling these data, considerable difficulty was experienced in obtaining homogeneous series owing to the more or less frequent change in methods of grading or of reporting price quotations.

The milk-price series is representative of raw-milk prices—bids to producers, in Snohomish County, which is the important dairying county lying just north of King County and Seattle. The milk here quoted is for manufacturing purposes and not for retail consumption and is expressed in dollars per hundredweight. The series is a long one commencing in 1919. From 1919 through September, 1929, the data were obtained from the *Post-Intelligencer*, but from September, 1929, to date they were furnished by the Consolidated Dairy Products Company, Seattle. In 1931 the data are averages for the months. From January, 1933, the prices are f.o.b. farm. There was a ten cents per hundredweight hauling charge. All prices with the above exceptions in 1931 are taken as of the first day of the month. It should be understood that these are representative prices and do not constitute the average of all milk produced or other than that handled through this one large dairy organization. The prices would not be precisely uniform on any one day, since there is no complete dissemination of knowledge as would be had through dealing on the Chicago Produce Exchange.

Poultry price data consist of wholesale prices for "leghorns" weighing 3–3½ pounds and represent the price per pound in cents. In 1920, 1921, and January and February of 1922, the price is for leghorns 4 pounds and under; then 3–3½ pounds to March, 1931. From April, 1931, to December, 1932, these are quoted as "heavy," "medium," and "light," and the "medium" weight was selected, since the series is not intended to be the price of the heaviest fowls. After December, 1932, the quotations were changed to "3½ pounds and under," and from January, 1937, on "hens—3–3½ pounds." Although perfect homogeneity is impos-

sible, the variations will not be sufficient, it is thought, to defeat the main purpose of the series as an indicator of the vagaries of price fluctuations in this important agricultural product of the Puget Sound Area.

TABLE 7

PRICE INDICES IN RELATION TO THE BUSINESS CYCLE

Business Activity Movement	Prices Rising	Prices Falling	Prices at Their Peak	Concurrent Change in Prices
Downturn of 1920	×			
Upturn of 1921		×		
Downturn of 1923			×	
Upturn of 1924				×
Downturn of 1926		×		
Upturn of 1927	×			
Downturn of 1929		×		
Upturn of 1932		×		
Upturn of 1933				×
Downturn of mid-1933	×			
Upturn of late 1933	×			
Downturn of 1934	×			
Upturn of 1934	×			
Downturn of 1937			×	
Downturn of late 1937		×		
Upturn of 1938		×		
Downturn of 1939		×		
Upturn of mid-1939				×

Wheat prices.—The only grain-price series used was for wheat. This monthly series commences in August, 1920, and is expressed in dollars per bushel. The series selected for presentation is that of the principal species or grade of wheat grown in this section of the country, namely, "soft white." The prices quoted are for "cash soft white wheat." As with all the other price series, one representative type was difficult to trace through the years. No quotations were to be had for September and October, 1921.

In the use of such series as these local consumers goods prices, it would be well to note the past history of general price indices in their relation to the movement of the business cycle. Table 7 presents price indices in relation to the business cycle.

It is evident from the above record that Bratt was correct when he said:

> Price changes do not represent a change in economic welfare, but a measurement of the particular effects of changes in the welfare of groups demanding and supplying the goods. Empirically, prices have not always followed the changes in economic activity.[25]

Not many other price series are currently available; the ones chosen were selected because they were the only fairly continuous series to be quoted regularly in the daily papers of Seattle.

[25] Elmer C. Bratt, *Business Cycles and Forecasting* (Chicago: Business Publications, Inc., 1937), p. 351.

CHAPTER III

DESCRIPTION OF COMPOSITE INDEX NUMBERS AND METHOD OF CONSTRUCTION

SERIES SELECTED FOR USE IN THE COMPOSITE INDEX NUMBERS

IN CONSTRUCTING composite indices of business activity for the Puget Sound Area, a number of perplexing problems arose having to do with the selection of series to be used in the indices, the statistical adjustment for seasonal and other variations, and the methods of weighting the series to reflect their relative importance in the economy. It is the purpose of this chapter to describe these problems and how they were attacked.

Two final series of composite index numbers of business activity for the Puget Sound Area were constructed. In one of these an attempt was made to remove the long-time trend from the individual series, whereas in the other composite index the trend was not removed from the component series. Both of these indices were composed of the same constituent series. For assembly in the two final series of composite index numbers, the following four subcomposite series were compiled: production, trade, finance, and shipping.

The individual series selected for use in each of the four subcomposites were as follows:

A. Production
   - Electricity sales, including three series, i.e., the Puget Sound Power and Light Company; the City Light Department, Seattle; and the Light Division, Department of Public Utilities, Tacoma
   - Cement production—Washington and Oregon
   - Lumber production—western coast of Washington and Oregon
   - Fish landed—Seattle
   - Employment—Washington
   - Coal production—Puget Sound Area and Kittitas County

B. Trade
   - Department-store sales—Seattle
   - Postal receipts, including four series, i.e., Seattle, Tacoma, Bellingham, and Everett
   - Gasolines sales—Washington
   - Newspaper advertising lineage, including two series, i.e., Seattle and Tacoma
   - New-car registrations—Puget Sound Area

C. Finance
   - Bank debits, including four series, i.e., Seattle, Tacoma, Bellingham, and Everett
   - Life insurance (ordinary)—Washington

D. Shipping
   - Exports—Washington Customs District
   - Imports for consumption—Washington Customs District

Production series used.—The series actually used in the production subcomposite index are all in physical units. Two production series which had been collected were not used—namely, value of fish landed at Seattle and factory pay rolls for Washington—because they were not in physical units and would have partially duplicated two series chosen for inclusion.[1] Following are the criteria used

[1] The series covering pounds of fish landed at Seattle was used instead of the value of fish landed at Seattle because the former series avoids the problem of the changing purchasing power of the dollar.

The factory-employment series was chosen instead of factory pay rolls for use in the production index primarily because it avoids the deflation problem. Neither series is quite suitable for measuring either total employment or business activity in the Puget Sound Area. These two series are for the state of Washington, and, although the bulk of the manufacturing is carried on in the Puget Sound Area,

for the inclusion of a series:

1. Representativeness of an important sector of the economy
   a) Adequacy of coverage of area, industry, or activity
2. Sensitiveness to cyclical changes
3. Availability
   a) Length of series
   b) Homogeneity and accuracy of data

In applying the criterion of representativeness, consideration was given to the ability of a series to represent the sector of the economy into which it was grouped with other similar series; the series had to be an important representative of production, trade, finance, or shipping. Consideration was given to the area from which the data were drawn, i.e., cities, counties, state, or larger area. Then the adequacy of coverage of the sample was considered within the industry or activity.

In order to measure the movement of business activity, the series should be sensitive to cyclical changes as well as representative of an important sector of the economy. Some of the series used are relatively quick in their short-term response to changes in industrial, trade, or financial activity and to changes in purchasing power in the Area. Examples of these are bank debits, department-store sales, and new-car registrations. Other series, such as postal receipts, life insurance sales, and exporting, reflect the changes developing over longer periods and do not act with promptness in the short-term movements of business activity.

The criterion of availability of the data has to do with the length of the time series, the uniformity of the data over the period covered, and the accuracy of methods used in collecting and reporting the data. Series were sought which covered the period from about 1921 through 1939. Homogeneity of the data was a necessary characteristic which limited the length of some series and prohibited use of others. The principal difficulties encountered in this regard concerned changes in methods of collecting and reporting the data, loss of records, and changes in company structure within recent years. Another point borne in mind was the acquisition of series expressed in physical units instead of dollars and cents as far as possible. When two series of a similar nature were available, the one expressed in physical units was selected in preference to the one expressed in dollars and cents. The purpose of this choice in series was to avoid as far as possible the intrusion of the changes in the purchasing power of the dollar.

Among the production series used, cement production, lumber production, coal production, and number employed in factories show fluctuations in business conditions for an area larger than the Puget Sound Area of fifteen counties. It was determined that the fluctuations in the production of coal in the sixteen counties used (Kittitas County was included) is highly correlated with the fluctuations of coal production in the fifteen counties of the Puget Sound Area as delimited. As for the correlation of the lumber production of the western coast of Washington and Oregon with the lumber production of the Puget Sound Area, there is reason to accept the fluctuations of pro-

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these indices fail to account for the important industries of agriculture, mining, fishing, and logging. In addition, no cognizance is taken of the employment and pay rolls of wholesale trade, retail trade, service establishments, government employment, and all the other occupations. Even in the manufacturing industry these indices omit fruit-, vegetable-, and fish-canning. Nevertheless, it was thought desirable to include one of the two employment indices, and choice was made of the one expressed in physical units—the number employed.

duction of the entire area as indicative of the movement in the Puget Sound Area of Washington because the western Washington production has ordinarily been 50 per cent greater than that of western Oregon and because the Puget Sound Area contains 85 per cent of the western Washington timber stand.

In cement production four large plants out of nine in the two states of Washington and Oregon are in the Puget Sound Area. It seems a fair assumption (although data are not available for checking its validity) that, with so large a proportion of the plants in the Area, the fluctuations of the production of the two states combined would be rather accurately reflected in the fluctuations in the Puget Sound Area. It is not possible to obtain Washington data separate from those of Oregon.

Employment in factories of the state would be found to be highly correlated with employment in factories of the Puget Sound Area if the facts were known, because since 1890 the number of manufacturing establishments in the Puget Sound Area compared with the number in the entire state varied between 65 and 75 per cent and the value of products manufactured in the Area ranged between 70 and 85 per cent of the total for the state. According to the census of 1940, about 75 per cent of the factories, of the wages paid, of the value added by manufacture, and of the value of products manufactured in Washington are attributed to the Puget Sound Area.[2] Puget Sound Area employment in factories would thus seem to be fairly represented by the Washington series.

Trade series used.—For the subcomposite of trade the principal indicators collected were used. Department-store sales of Seattle do not differ greatly from those of the so-called Pacific Northwest as shown by the index numbers of the Federal Reserve Bank of San Francisco. Department-store sales of Seattle represent the retail-store trading of the Area. This series is admittedly weak for this purpose, but it is the best available series covering more than two or three years.

Postal receipts of the four largest cities were combined into one series for use in the index. As noted in chapter ii these receipts comprised 84 per cent of the postal receipts of the sixteen cities of the Area from which such data were gathered. The weights used for combining the four city postal-receipts series for use in the index of trade were on the basis of the average postal receipts of each year. The weights were in this way changed from year to year.

Gasoline sales, which are for the entire state, should represent the Puget Sound Area rather adequately because two-thirds of the passenger cars and over one-half of the trucks and buses were registered in the Area in the years 1939 and 1940.[3] The mere registration of vehicles is not conclusive evidence that the Puget Sound Area gasoline sales are highly correlated with those for the entire state, but in the absence of county statistics it is assumed that the sales would be roughly in proportion to the number of vehicles and that the movement in Puget Sound Area sales would dominate the movement in the Washington sales series.

Newspaper advertising in the two largest cities of the Puget Sound Area is considered an adequate sample of the amount of newspaper advertising sold in the Area. New-car registrations refer to

[2] U.S. Bureau of the Census, *Sixteenth Census of the United States Taken in 1940, Preliminary Report: Washington* (Washington: Government Printing Office, 1941), pp. 2–3.

[3] State of Washington, Department of Licenses, *Reports Covering Registration of Motor Vehicles by Counties for the Years 1939 and 1940.*

the fifteen counties of the Puget Sound Area.

The only series in this section collected but not used in the composite index numbers are those of flour and wheat receipts, livestock receipts and slaughterings, and the telephone series. Flour receipts are of limited importance as measures of local business activity because the flour shipped into the Puget Sound Area is chiefly for export and thus affects a relatively small number of warehouse and dock workers. Wheat receipts are not reliable as an indicator of local business activity for the reason that they do not necessarily correspond with general business activity. Their timing is inaccurate, and they are affected by outside conditions. Tariff changes, quota restrictions, and foreign trade conditions affect the receipt of wheat for export. The wheat market is affected by conditions in other countries which destroy the effectiveness of local receipts as a measure of local business activity. Livestock receipts and the number of livestock slaughtered are not nearly so prompt and responsive as department-store sales, gasoline sales, and newspaper advertising lineage for the measurement of trade, and, furthermore, they involve some element of production as well as trade. The telephones-in-service series reacts slowly in its measurement of business activity. Although a series covering long-distance telephone calls is prompt and is felt to be a good measure by the telephone company, the series covers too small a section of the telephone business of the state.

Financial series used.—Financial series are fewer than is to be desired, but the most representative series collected were included in the index. Bank debits of the four largest cities are taken to be an adequate sample of the bank debits of the Area. The population of these four cities is 48 per cent of the population of the Area, and the four counties in which these four important financial centers are located have 75 per cent of the population of the Puget Sound Area. Life insurance sales of Washington, though a much less adequate indicator of business activity, were included because it was desired to have more than one type of financial indicator. Sales of ordinary life insurance do not react quickly to business activity changes but respond to the general movement. While life insurance sales seem to be financial in character, involving, as they do, the element of saving as well as confidence in future earning power, they are sometimes used with bank debits in index numbers designed to measure trade conditions.[4] The slowness with

[4] Ordinary life insurance sales are used together with bank debits, department-store sales, and new-car registrations in the regional trade barometers prepared for *Dun's Review* by Dr. L. D. H. Weld: "Scientific Determination of Regional Sales Potentials," *Dun and Bradstreet Monthly Review*, November, 1935, p. 1, and *ibid.*, January, 1936, p. 1; "New Barometers for Measuring Trade by Regions," *ibid.*, September, 1936, pp. 2–5; "The Regional Trade Barometers and Other Sectional Indexes," *Dun's Review*, July, 1937, pp. 14–16; "How To Use the Regional Trade Barometers," *ibid.*, April, 1938, pp. 23–26; "How Consumer Purchases Vary with the Seasons in 29 Regions," *ibid.*, June, 1940, pp. 1–6; and "The Regional Trade Barometers—Construction and Use," *ibid.*, January, 1941, pp. 1–4.

The University of Pittsburgh uses life insurance sales as a financial measure, while the University of Indiana uses them as a measure of trade. It was stated: "Life insurance sales in Indiana since 1921 have shown about the same degree of variation as department store sales. It might be presumed that conditions in the security market might have a more direct influence upon life insurance sales than upon the retail distribution of commodities, but this has not been true in Indiana, for the movement of department store and life insurance sales have been quite uniform in both direction and degree. This does not imply that there is necessarily a close relationship between the two series, but it does seem to indicate that virtually the same factors have affected both lines of activity. . . . . Life insurance sales are a measure of consumer purchasing power and follow more closely the movement of retail trade than that of an index of industrial production like pig iron for

which sales of life insurance react is the chief weakness of the series. The sales cannot be obtained for separate counties or cities, and sales for the entire state must be used. It is felt that not less than two-thirds of the volume of ordinary life insurance business of Washington would be sold in the Puget Sound Area, which contains about two-thirds of the population, and for this reason the movement of life insurance sales in the Puget Sound Area would appear to be fairly represented by the Washington series. However, ordinary life insurance is but one of several kinds of life insurance, and it might be that various other types are preferred in districts outside the Puget Sound Area to such an extent as to make the Washington series unrepresentative of the Puget Sound Area.

The series of number of business failures collected is too short to use; furthermore, it is too erratic and has a considerable lag. The bank deposits series are for Seattle only and would not reflect activity with accuracy or promptness.

Shipping series used.—The shipping subcomposite index includes simply imports and exports of the Washington Customs District. Series representing the two largest ports of Seattle and Tacoma would have been used because they could have been had in tonnage had they not been abruptly stopped by Treasury Department order in September, 1939. The two series used are perhaps more reliable as indicators of shipping activity in the Puget Sound Area than carloadings or the other series listed in chapter ii and have an advantage in length of years covered. Moreover, the imports and exports series are collected for a district more closely identified with the Puget Sound Area than is the area from which the carloading statistics are assembled.

As indicators of business activity in the Puget Sound Area, export and import series are subject to qualification. The export series seems to reflect changes in general business conditions more clearly than the import series, but both of these shipping series are greatly influenced by conditions in other countries which affect foreign trade. Changes in the tariff, trade agreements, and foreign exchange have an influence on imports and exports which reduces the effectiveness of these series as measures of local business activity. Other factors inherent in the data and the method of their collection which reduce their value as measures of regional business activity were discussed in chapter ii.

STATISTICAL METHODS USED IN ADJUSTMENT OF SERIES

Adjustment for calendar variations.—Almost all series require adjustment because of the varying lengths of the months or the varying number of working days, Sundays, and holidays in the different months.

Many businesses, especially public utilities, operate every day in the week regardless of Sundays and holidays, while others observe Sundays, holidays, and even close on Saturdays. The adjustment of a series for the calendar consists of dividing the original data by the number of working days or calendar days of the months, thus reducing the series to an average daily series and putting each month on a basis comparable with every other month.

As regards the series used in the composite index numbers, the following adjustments were made for the calendar:

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example" (George W. Starr, *Measures of Business Conditions in Indiana* ["Indiana Studies in Business," Vol. II, No. 2 (Bloomington: Indiana University, 1934)], pp. 46–47).

Adjusted for the number of days of the month: electricity sales, fish landed (pounds), gasoline sales, newspaper advertising lineage, new-car registrations, life insurance sales, exports (value), and imports (value)

Adjusted for the elimination of Sundays and national holidays: cement production, lumber production, coal production, and postal receipts

Adjusted for the elimination of Sundays, national holidays, and bank or local holidays: bank debits

Adjusted by the methods used by the Federal Reserve Bank of San Francisco in computing their index-number series: department-store sales and factory employment

Adjustment for seasonal variation.—Except for the seasonally adjusted index-number series of department-store sales and factory employment, which were computed by the Federal Reserve Bank of San Francisco, all series were adjusted for seasonal variation. The method used in all cases was the "ratio-to-twelve-months-moving-average method." This method consists, briefly, of taking a twelve-months-moving-average of the series followed by a two-months-moving average, for the purpose of centering the average exactly on the middle of the month commencing with the seventh month of the series and ending with the seventh month from the last. The two moving averages are combined into one operation in the laboratory. The calendar-adjusted data are then divided by the moving average series month for month, and the resulting percentages are set down in monthly arrays and also on a multiple frequency table or scattergram for study of their distribution. The scattergram assists in deciding upon the type of average of the arrayed percentages to use in order to obtain the most representative monthly averages of the ratios to the moving averages. After these twelve representative index numbers are computed, they are adjusted to total 1,200, and the twelve constant seasonal index numbers may be used to represent the recurring seasonal pattern of the time series. This procedure is explained in detail with illustrations of the technical steps in elementary textbooks on statistics.[5] The method was originally explained by Joy and Thomas in 1928 in an article setting forth the experiences of the Federal Reserve Board with this method.[6]

Use of changing seasonals.—There were three series in which it was decided to compute changing seasonal index numbers due to the unstable, varying conditions of the past few years, viz., cement production, lumber production, and new-car registrations. The method of computing these moving seasonal indices may be summarized briefly as follows:

1. Compute twelve-months-moving-averages of original data
2. Divide original data by these moving-average figures and express as percentages
3. Plot these percentages for each month, by years
4. Smooth with a five-term (or other) moving average
5. Draw a freehand trend line and read values from it
6. Adjust these first approximation figures to total 1,200 for each year, at the same time retaining a smooth, well-fitting trend

This method is explained in detail with illustrations by Croxton and Cowden[7] and in an original article by Joy and Thomas in 1928.[8]

[5] F. E. Croxton and D. J. Cowden, *Applied General Statistics* (New York: Prentice-Hall, Inc., 1939), pp. 471–84; J. R. Riggleman and I. N. Frisbee, *Business Statistics* (New York: McGraw-Hill Book Co., Inc., 1938), pp. 320–22; F. C. Mills, *Statistical Methods* (New York: Henry Holt & Co., 1938), pp. 284–87; J. R. Stockton, *An Introduction to Business Statistics* (New York: D. C. Heath & Co., 1938), pp. 174–85.

[6] Aryness Joy and Woodlief Thomas, "The Use of Moving Averages in the Measurement of Seasonal Variations," *Journal of the American Statistical Association*, XXIII (September, 1928), 241–52.

[7] *Op. cit.*, pp. 500–508. [8] *Op. cit.*, pp. 247–49.

Method of removing seasonal variation.—All seasonal variations were removed from the calendar-adjusted series by division because it had been assumed in computing the seasonal index that the relationship between the seasonal, trend, and cyclical plus random fluctuations is multiplicative rather than additive. In this first experiment of composite index-number construction for the Puget Sound Area, the method used for removal of the seasonal and trend fluctuations—namely, by division—is the one most commonly advocated, but it does not follow that it is in all cases the most precise method to use. There are many ways in which relationships between seasonal variation, long-time trend, cyclical fluctuations, and random fluctuations can combine themselves in the original data. There are likewise corresponding formulas to express these relationships.[9] The proper method to use in the isolation of the cyclical element thus depends upon which of the formulas is assumed to express the relationships of the factors. When the factors are assumed to be combined in a multiplicative manner throughout, the equation becomes

$$\text{Original data} = (\text{seasonal}) \times (\text{trend}) \times (\text{cyclical} + \text{random fluctuations}).^{10}$$

This formula assumes (1) that the amplitude of the seasonal variation is proportional to the cyclical level, that is, greater in prosperity than in depression; (2) that the amplitude of the seasonal variation is proportional to the level of the long-time trend; and (3) that the amplitude of the cyclical fluctuations is proportional to the level of the long-time trend.

Inspection of the charts of the twenty-four series used in the composite indices and in tables gives evidence that the multiplicative relationship hypothesis is the appropriate one to assume for the elimination of the seasonal variation. Clearly evident is the relative relationship between the factors of seasonal and trend and those of seasonal and cyclical. Typical examples are the series of gasoline sales, imports, life insurance sales, exports, department-store sales, newspaper advertising lineage, cement production, and bank deposits of Seattle. The relative relationship is not so clearly evident in the postal receipts, fish landed, and the Seattle City Light Department series, nor in the latter part of the Bellingham and Everett bank debits and the Bellingham postal receipts series. Coal and lumber production series are too short to show the relationships clearly.

The relationship between trend and cycle is not apparent from inspection of the series because of their comparatively short duration; therefore, it has been assumed to be a multiplicative relationship for the purpose of removal of the long-time trend in one of the two composite indices.

If the trend is divided out when it should be subtracted, the result is to show a cycle, which has remained constant in amplitude when measured in absolute amounts, as a cycle with increasing (or decreasing) violence, depending on whether the measurement is made relative to a decreasing (or increasing) level of the long-time trend. If the trend is subtracted when it should be divided out, the result is to show a cycle of increasing (or decreasing) violence for a cycle which has shown an increasing (or decreasing) amplitude when measured in

[9] E. C. Bratt, *Business Cycles and Forecasting* (Chicago: Business Publications, Inc., 1937), pp. 70–76.

[10] The cyclical and random fluctuations are usually handled as one factor because of difficulty of separation and/or a belief that there is no logical difference between them (*ibid.*, p. 70).

absolute amounts, although this cycle would show no increase (or decrease) in amplitude if divided out.[11] Perhaps neither of these results is of the sort likely to produce gross misinterpretation. At any rate it is a hazard which should be recognized in the use of an index which has had the trend removed from the series composing it.

Adjustment for long-time trend.—One of the two final composite index numbers was compiled from series which were adjusted for long-time trend as well as for the calendar and seasonal variations. In making this trend adjustment, many experiments were tried on these series in an effort to find simple curves or lines of best fit which would also be logical when the period of the data was considered. The period since World War I has been marked by a sharp depression in 1920–21; minor depressions or recessions in 1924 and 1927; a boom culminating in a very drastic slump starting in 1929 but with considerable recovery by 1937, only to be followed by a sharp drop in that same year. For the years 1938 and 1939 the movement, though generally upward, was wavering and uncertain. It is a hazardous task to fit trend lines covering the past decade. In this uncertain period of the last ten years statisticians have frequently abandoned the practice of trend removal or have presented two series of index numbers, one of which leaves the long-time trend in the data.[12]

For the purpose of removing an approximation of the long-time trend from the series used in one of the two final composite index numbers, trends were fitted by the least-squares method to all series except lumber production. In using this method, care must be exercised in selecting the period and the function. The addition or subtraction of one month from a time series will alter the slope of the fitted trend line. There is a decided disadvantage in series which are too short, particularly when the period used is one in which the movement of the business cycle is forcing the trend in a direction which, from logical reasoning based upon experience and observation, is contrary to that known to exist. In some cases it may be more sensible to use an arithmetic mean of the data as the trend from which deviations should be measured. Several of the series used in the composite indices of business activity are too short to enable one to obtain a satisfactory trend for them. However, an attempt was made to eliminate a portion of the indicated trend in each instance either by a fitted curve or by an average of the series.

Experiments were tried in fitting a parabola to the lumber-production data and also in using broken-line trends for lumber production, but neither measure was satisfactory. Each of these trend measures appeared to be highly arbitrary in view of the nature of the data and the shortness of the period covered. In this case the average was decided upon as the most appropriate estimate of the point from which cyclical deviations should be measured.

One of the chief reasons for calculating two types of composite indices, aside from the interest in the movement of a series with the long-time trend left in the data, is the difficulty of deciding how the trend can best be measured when the period of the data is short or the period

[11] *Ibid.*, pp. 73–74.

[12] See indices of general business activity in the Pittsburgh district published monthly in the *Pittsburgh Business Review*. One monthly index is based on 1923–25 average = 100, and another is based on a statistical "normal" equal to 100 per cent. In the latter index the long-time trend, as well as the seasonal variation, has been removed from each of the component series.

being measured is characterized by unusual movement in depression or expansion.

Adjustment for purchasing power of the dollar.—No attempt has been made to adjust any of the bank debits, postal receipts, or other dollar-value series for the changing purchasing power of the dollar because of the uncertainty which attaches to the selection or construction of an appropriate index series to use as a deflator. It must be acknowledged that such an adjustment is theoretically proper. However, because of the difficulty of deflating any series without injecting more error into it than is already there, the problem requires more complete data and information, as well as more thorough investigation, than could be provided for this study. Every effort was made to obtain series expressed in unchanging statistical units of measurement such as the pound, kilowatt hour, and barrel.

Types of composites computed.—Out of these hundred and ten series, twenty-four series were selected for experimentation in the compilation of composite index numbers. One composite was compiled from these twenty-four series after they had been adjusted for calendar variation, seasonal variation, and long-time trend; the other composite series was made up of the same twenty-four series but with the difference that the long-time trend was not removed and that each series was individually placed on the uniform base period of 1935–37 average = 100 per cent before the series were combined in the final composite index numbers.

Selection of the base period.—The selection of the base period of 1935–37 as equal to 100 per cent was made after considerable deliberation. At the time of decision the Federal Reserve Board was using the base period of 1923–25, which it adopted in 1927. It was stated at the time of the selection of the years 1923–25 as a base period that the average of these years was selected principally because it was the most recent period available at the time the index was under construction, and recentness for the base makes the index more significant for current comparisons for several reasons: (1) it is familiar; (2) the current variations of the individual series from the base are less likely to be extreme than if a more distant period is used; and (3) it permits the inclusion of some sets of data which have been available for only a short time. The use of three years gives a broader basis of comparison than one year and is not influenced to the same extent by exceptional conditions.[13]

A similar line of reasoning was followed in the selection of the base period 1935–37 used in this study. Upon examination of many series for the United States and the Pacific Coast region as well as for Washington and the Puget Sound Area, the following factors appeared:

1. The period should be longer than one year because of the uncertainty of movement in most of the series over the last ten years. The fluctuating condition of business brought about by uncertainties injected by new social and reform legislation following the stock-market crash of 1929 required a longer base in order to avoid extreme variations.

2. Owing to the scarcity of data in some fields in the Puget Sound Area, many of the series are relatively short and would not permit of comparison on a base selected prior to the depression which started in 1929.

3. The years 1935, 1936, and 1937 as a group were perhaps as balanced and as free from great fluctuations as any period that could be selected after the period of

[13] "The New Index of Industrial Production," *Federal Reserve Bulletin*, March, 1927, pp. 170–75.

recovery was under way from the bottom of the depression in 1932 and 1933.

4. It was advisable to keep away from the years of slump from 1929 to 1932 and from the two years of uncertain rise in 1933 and 1934.

5. The period 1935–37 is recent and therefore is familiar to all.

6. The average of the years 1935–37 was being given serious consideration by the Federal Reserve Board, the Bureau of Labor Statistics, and other important statistical agencies, with the idea of changing from the long-used base of 1923–25. This indicated that a recent base period was advisable and that the three years contemplated were being given scrutiny and earnest study by those long experienced in the compilation of important national index-number series.

The question of a change in base period was given considerable attention by various members of important government bureaus at a meeting of the Washington Statistical Society in February, 1938. One reason advanced for making a change to a more recent period such as 1935–37 was that a later base would facilitate the use of new weights for component series, although the weight period and base period do not have to be the same. The great difficulty of selecting a specific period that would be sufficiently stable to justify a change in the base of government index numbers generally merited postponement of the decision until 1939 or 1940, when additional information would permit more careful consideration of the problem.[14]

Another opinion was that 1935–37 as a base would be unsatisfactory because they were years of considerable instability in prices, with sharp declines in production during the latter part of the period. The relative importance of durable and nondurable goods and the relationship between employment and pay rolls during this period are not likely to be typical of the next ten years. The influences of government payments such as the veterans' bonus, subsidy to farmers, and relief expenditures contributed in making the period an abnormal one. Dispersion of relatives based on this period would soon be greater than from the old base.[15]

From the viewpoint of the Bureau of Labor Statistics a change was unavoidable and imperative for certain indices and should be made as soon as possible. This new base must include or be subsequent to 1935. New cost-of-living and retail price series were being collected and indices prepared which could not be satisfactorily related to any base prior to 1935. The same was true for wholesale prices and for man-hours data which were not collected by the Bureau until 1932.[16]

It was stated that this new period 1935–37 was being considered because it contained two Census of Manufactures years.[17] Further comment made at this meeting was against 1935–37 as a base. Although a new recent base was desirable, it was held that 1935–37 was too recent to permit necessary perspective—the decision should be withheld until 1941. A satisfactory base should be somewhere near the median of extreme fluctuations and should be years of rela-

[14] "Report on Meeting of the Washington Statistical Society, February 28, 1938," *Journal of the American Statistical Association*, XXX, No. 202 (June, 1938), 411–15. Talk by M. R. Conklin, of the Division of Research and Statistics of the Federal Reserve Board.

[15] *Ibid.* Talk by Lowell J. Chawner, Division of Economic Research, Bureau of Foreign and Domestic Commerce.

[16] *Ibid.* Talk by Aryness Joy, Bureau of Labor Statistics.

[17] *Ibid.* Remark made by Mr. Wilcox, of the Bureau of Labor Statistics.

tive stability when the various component series run approximately parallel. A three-year base is not long enough; a five-, six-, seven-, or even ten-year base is preferable. The Department of Agriculture is at present tied by legislation to a pre-war base, 1910–14. One of the newer series of farm wages uses a base 1924–29 temporarily.[18]

The Federal Reserve Board announced in August, 1940, a change from the old three-year base of 1923–25 to a new five-year base of 1935–39.[19] The Bureau of Labor Statistics announced in their August, 1940, bulletin a change of like character covering cost of living. In reporting the revised index of industrial production and its component series, it was stated that the principal difference between the old and the new series is that the new index shows much more growth in this country's industrial output than was shown by the former index. As it happened, there is great similarity shown as to the current general level due largely to the fact that the old index happened to average 99 per cent for the years 1935–39, the base selected as 100 for the new index.[20]

METHODS OF WEIGHTING THE IMPORTANCE OF THE SERIES

Necessity for weighting series.—The combination of the series into the general indices of business activity required the application of weights to express, as nearly as possible, the importance of the group represented by the series.

The problem of weighting series to be combined is twofold: first, it is necessary to determine the weight to be given each major activity, such as production, trade, finance, and shipping, and, second, weights must be assigned the individual series comprising the major groups.

It is a generally accepted principle that weighting cannot be determined solely on the basis of statistical data, even where such information is comparatively complete and readily obtainable. The basic objective in weighting is the expression of the economic importance of an activity. For this judgment such criteria are used as the value added by manufacture, the total value of production, and the representativeness of the series. Where objective criteria are either inadequate or unavailable, personal judgment is used to determine the weights to be applied to the series. Personal judgment of the importance of the series, or the group of series they represent, relies upon familiarity with the series and the region they cover and upon knowledge of the economic history of the territory.

Weighting major activities.—It is difficult to obtain a clear idea of the importance of production activity as compared with trade, finance, and shipping, since there is no way to put these activities on a comparable basis. One must apply the weights of the major classifications arbitrarily if at all. The individual industries comprising production activity can be weighted largely on the basis of value of product. However, this is not entirely satisfactory, since a series, such as electric-power production, because of its universal use in all industries including those with which it is being compared, is of greater importance than a weight assigned solely by value of product would indicate. As between production and trade there is no completely satisfactory way to determine relative importance by

[18] *Ibid.* Talk by O. C. Stine, Division of Statistical and Historical Research, Bureau of Agricultural Economics.

[19] "New Federal Reserve Index of Industrial Production," *Federal Reserve Bulletin*, August, 1940, pp. 753–71.

[20] *Ibid.*

the use of statistical data because neither value of product nor "value added" by the activity would take care of such series as postal receipts, newspaper lineage, or new-car registrations, which are more or less acceptable measures of trading activities.

Need of changing weights.—There is another problem in the assignment of weights which has to do with the changing importance of individual branches of business activity. Changing weights are used in order to allow for the fact that at one time the series measuring production may be of greater importance in the measurement of general business activity than are the series measuring trade, shipping, or financial activity, while at another time the relative importance of the major groups of series may be in quite different relationship.

Addition of new series.—Another consideration in weighting is that the weights of the various major groups of series need readjustment whenever a new series is added. The entrance of a new series does not necessarily cause an artificial movement of the index at the point of entrance but will change the characteristics of the index to some extent.

From study of the individual series entering into the various subcomposite index used in the general indices, it was seen that, because of their nonuniform lengths and their character as indicators, their weights could not be kept the same for all years. The importance of the subcomposite series tended to increase or decrease in their relation to one another in the final composite index numbers.

Weighting method adopted.—It was decided to place weights upon the individual series in each subcomposite index, then upon the subcomposite indices, and, finally, to study the relationships in the light of economic conditions over the years chosen for the index series in order to adjust these weights as conditions seemed to warrant.

In working out the weights, it was found desirable to begin in the present and work backward in time, commencing with the largest number of series to be used and adjusting the weights as the short series drop out. Adjustment of the weights as series were dropped was made by adding a proportion of the weight of the discontinued series to those remaining.

Study of the importance of the various production series led quite naturally to placing the greatest weight on lumber production because the lumber industry is, and for many years has been, the principal industry of the Puget Sound Area.[21]

Inasmuch as it is impossible to obtain monthly statistics of the production of paper and pulp, plywood, furniture, wooden boxes, planing-mill products, and wood-preserving products, the forest industries must all be represented in the index numbers by lumber production. The importance of the forest industries of Washington to all manufacturing as measured in value of production is approximately as shown in Table 8. The wages paid in the forest industries of Washington as compared with wages paid in all manufacturing industries of the state are also presented.

Although no statistics are available as to just how much of the timber cut in this area goes into paper and pulp, the records of the Census Bureau show that the percentage of the value of forest

[21] According to the Weyerhaeuser Timber Co., the forests of Washington provide 62 per cent of the industrial pay rolls, 44 per cent of the industrial products, 32 per cent of the population with livelihood, 80 per cent of the outbound water freight, and 67 per cent of the rail freight (*Seattle Times*, Tourist and Trade Section, July 28, 1940, p. 10).

products (including wood-preserving and furniture but excluding paper and pulp) formed by the value of paper and pulp products has been as shown in Table 9. Lumber production was given a weight of 50 out of 100 in the production index.

Electric-power production is represented by electricity sales, and, as explained in chapter ii, electricity sales are representative of many phases of business activity, including production, trade, and shipping. Electricity power usage is an inclusively representative series, particularly in a region in which electricity can be produced in large quantities at low cost, because it varies with the changes taking place in production, distribution, and other phases of business activity. As this series represents many industries not otherwise specifically included in the index, it is arbitrarily weighted at 25, or half the weight of lumber production.[22] However, since this series includes much residential, street-transit, and street-lighting electricity usage, the first of which has rapidly increased during the past decade, it is not considered so important as it would be if it were a purely industrial series. On the other hand, domestic use of electricity is likely to be quite constant, cyclically, and may not vitiate electricity production as a business activity index.

TABLE 8*

COMPARISON OF FOREST INDUSTRIES AND ALL MANUFACTURING IN WASHINGTON, 1929–39

Year	Value of Products (Per Cent)	Wages Paid (Per Cent)
1929	44.3	61.8
1933	41.9	53.0
1935	39.9	57.6
1937	45.1	63.2
1939	42.4	50.5

* Source: U.S. Census of Manufactures.

Factory employment is made up from data of rather scattered nature and is not so satisfactory as might be desired. This series purports to represent factory employment exclusive of the fish-, fruit-, and vegetable-canning industries. As previously stated in chapter ii, it is inadequate because it does not include labor engaged in agriculture, fishing, mining, logging, wholesale and retail trade, and the service establishments. A more satisfactory series for measurement of business activity as far as production is concerned than either number employed or the amount of pay rolls would have been man-hours worked. This series is not yet available, however. In Washington the number employed and the amount of pay rolls are rather closely correlated and, from examination of the index numbers, would measure production changes equally well. This series is weighted 10 out of a total of 100 for production because of its representation in all factory production except the canning industry and because of the feeling that, although it is not based upon regularly collected monthly statistics, it is more sensitive than such series as cement, fish, and coal, which were also used in this index.

TABLE 9

COMPARISON OF PAPER AND PULP PRODUCTS TO FOREST PRODUCTS IN WASHINGTON, 1929–39

Year	Per Cent	Year	Per Cent
1929	15.4	1937	38.9
1933	41.3	1939	38.7
1935	39.5		

The series of cement production, coal

[22] Series represented but not included specifically are: flour mills, meat-packing, canning, bakeries, printing, shipbuilding, foundries, dairies, steel mills, and small machine shops.

production, and pounds of fish landed at Seattle were each given a weight of 5 because their production value is small in the aggregate of total value of products. The coal-production series is rather short and is not of great importance in the economy of this Area. Fish landed at Seattle is included because there are no monthly data covering the great fishing industry of the North Pacific regions of Alaska for which Seattle is the principal outfitting and supply center as well as the main warehousing, brokerage, and marketing point. This series is in one way the representative of the salmon-packing industry, but, of course, the amount of fresh fish landed at Seattle per month does not measure accurately the business activity of the Area ascribed to the salmon fishing and packing in Alaska. It is not yet possible to obtain data on the amount of fish shipped from Seattle each month by rail, water, and highway, so we have only annual data by which to measure the productiveness and value of the fishing industry to the Area and no definite way of determining the business activity of the principal part of the fishing industry—the highly seasonal salmon-packing industry.

Cement production is not a major industry of this Area, and the data obtainable are for the combined states of Washington and Oregon. The series should be included because of its reflection of building activity and because it is one of the few production series for which monthly data can be obtained, even though tardily. These three series are included at a weight of 5 each. They are thus given representation in the index of production, but their importance in the economy of the Area is probably not overweighted.

It will be observed that the weights in the production index were changed slightly prior to 1932 because of the fact that coal production was not included until that date. This tends to increase the importance of the other series slightly for the years 1929, 1930, and 1931. In 1929 lumber production was valued at 262.6 million dollars, but by 1931 this was down to 95.8 million dollars. It is seen that from 1929 on lumber production lost some of its strength as an indicator of production activity. The per cent of value of products of the forest industries compared with the value of products of all manufacturing industries in Washington dropped from 44.3 in 1929 to 41.9 in 1933 and down to 39.9 in 1935. During the period from 1929 to 1939 the trend of electricity production has been upward.

Prior to 1929 the very important lumber series as well as the fish and employment series are unavailable, so that the production index is represented only by electricity sales and cement production. As between electricity sales and cement production, the weights 84 and 16, respectively, have been used because the former is very much more important than the latter as representative of production activity in the Area. The percentages retain the approximate relationship of the period 1929–39. However, prior to 1926 the cement-production series departs from the index, and this leaves only the composite of the three electricity sales series to act as representative for the production activities of the Area. This series therefore has 100 per cent weighting for production prior to 1926, but adjustment is made in the weights assigned the four main subcomposite indices which make up the indices of general business activity.

In the index of trade the two principal measures of business activity were thought to be department-store sales and

new-car registrations. The department-store sales series represents retail selling in Seattle, the chief city of the Puget Sound Area. New-car registrations represent the sales of all types of automobiles in the fifteen counties of the Area. These two series reflect the purchasing power and inclination of the people to spend their money. It was thought that a weight of 25 each for these important trade indicators would give them adequate representation from 1927 through 1939. Newspaper advertising lineage is next in importance in reflecting the trading activity as its magnitude, in department stores, for example, is a percentage of the budgeted sales volume. The percentage varies from department to department and changes with the seasons of the year. The newspaper advertising lineage series is weighted 20. The other two series—postal receipts and gasoline sales—reflect the consumption activities of nearly all the people in the community but do not react quickly to business activity changes. Postal receipts vary with local business, owing to the use of the mails for advertising purposes. The parcel post is heavily used by mail-order establishments and by the mail-order departments of all types of trading organizations. The expansion of the air mail has increased the business of the postal department as air mail has become more widely used by the public. Postal receipts are not strong indicators of business activity as are department-store sales but are included because of the universal usage of the post office in all localities.

Gasoline sales is also a general over-all indicator of consumer buying. The considerable use of automobiles for street and highway transportation and delivery services of all kinds; the use of public and private automobiles and boats, as well as the many gasoline engines which provide power in construction, highway building, and industrial enterprises; and the great use of gasoline on farms and in orchards to operate pumps, tractors, and spraying machines make the sale of gasoline an important over-all series similar to bank debits and electricity sales. Gasoline sales and postal receipts were each given 15 per cent weighting out of a possible 100 for the trade index.

Since the new-car registration series is not available prior to 1927, the weights of the remaining series in the trade index required adjustment. For the years 1925 and 1926 weight increases were made in department-store sales to 33, newspaper advertising to 27, and postal receipts and gasoline sales to 20 each. As in the case of the production index, the importance of the trade index decreases as it loses its effectiveness, owing to reduction of the number of representative series. In 1922–24 only three of the five original series are left—postal receipts, department-store sales, and gasoline sales. In these three years the weights allowed are 60 for department-store sales and 20 each for the other two series.

The finance index is composed of bank debits and life insurance sales and covers the period from 1922 through 1939. Since the former series is so widely representative that it is frequently used as a general over-all business activity measure, it is given a weight of 90 as compared with 10 for life insurance sales. As the series extend backward in time, the finance index becomes more important with the years in the general business activity index, because the production and trade indices lose some of their ability to measure business activity, owing to loss of important series.

The shipping index is composed of two series, namely, value of imports in the

Washington Customs District and value of exports in the Washington Customs District. Each of these series covers the period from 1922 through 1939 and is given equal weight in the shipping index. This index also increases somewhat in importance as it goes backward in time, since water-borne commerce has become of less consequence in the economy of the Area during the two decades since World War I. Furthermore, the production and trade indices become weaker measures, as they lose some of their important series in the earlier years.

TABLE 10

WEIGHTS OF SUBCOMPOSITE INDICES

Index	1922–26	1927–28	1929–39
Production	25	25	40
Trade	30	35	35
Finance	35	30	20
Shipping	10	10	5
Total	100	100	100

In computing the two indices of business activity, with trend removed and with trend left in the series, it was felt that some adjustment was required in the relative weighting of the four subcomposite indices used, since they undergo drastic changes in earlier years. The subcomposite index weights used are shown in Table 10.

In 1929 the production series became more important as an indicator of busi-

TABLE 11

WEIGHTS USED IN COMPUTING COMPOSITE INDEX NUMBERS

Series	1922–24	1925	1926	1927–28	1929–31	1932–39
Production:						
Electricity sales	100 (25.0)*	100 (25.0)	84 (21.0)	84 (21.00)	26.5 (10.60)	25 (10.00)
Cement production	.....	.....	16 (4.0)	16 (4.00)	5.0 (2.00)	5 (2.00)
Lumber production	.....	.....	.....	.....	52.5 (21.00)	50 (20.00)
Fish landed—pounds	.....	.....	.....	.....	5.0 (2.00)	5 (2.00)
Factory employment	.....	.....	.....	.....	11.0 (4.40)	10 (4.00)
Coal production	.....	.....	.....	.....	.....	5 (2.00)
Total weight	100 (25.0)	100 (25.0)	100 (25.0)	100 (25.00)	100.0 (40.00)	100 (40.00)
Trade:						
Dept.-store sales	60 (18.0)	33 (9.9)	33 (9.9)	25 (8.75)	25.0 (6.75)	25 (8.75)
Postal receipts	20 (6.0)	20 (6.0)	20 (6.0)	15 (5.25)	15.0 (5.25)	15 (5.25)
Gasoline sales	20 (6.0)	20 (6.0)	20 (6.0)	15 (5.25)	15.0 (5.25)	15 (5.25)
Newspaper advertising	.....	27 (8.1)	27 (8.1)	20 (7.00)	20.0 (7.00)	20 (7.00)
New-car registrations	.....	.....	.....	25 (8.75)	25.0 (8.75)	25 (8.75)
Total weight	100 (30.0)	100 (30.0)	100 (30.0)	100 (35.00)	100.0 (35.00)	100 (35.00)
Finance:						
Bank debits	90 (31.5)	90 (31.5)	90 (31.5)	90 (27.00)	90.0 (18.00)	90 (18.00)
Life insurance sales	10 (3.5)	10 (3.5)	10 (3.5)	10 (3.00)	10.0 (2.00)	10 (2.00)
Total weight	100 (35.0)	100 (35.0)	100 (35.0)	100 (30.00)	100.0 (20.00)	100 (20.00)
Shipping:						
Imports	50 (5.0)	50 (5.0)	50 (5.0)	50 (5.00)	50.0 (2.50)	50 (2.50)
Exports	50 (5.0)	50 (5.0)	50 (5.0)	50 (5.00)	50.0 (2.50)	50 (2.50)
Total weight	100 (10.0)	100 (10.0)	100 (10.0)	100 (10.00)	100.0 (5.00)	100 (5.00)
Grand total	(100.0)	(100.0)	(100.0)	(100.00)	(100.00)	(100.00)

* The figures in parentheses are the weights of the individual series in the final composite indices. Those not in parentheses are the weights used in compiling the subcomposite index numbers.

ness activity because of the addition of the employment, fish, and particularly the lumber-production series. The weight of the trade index was increased in 1927, when, through the addition of the series of new-car registrations, it became a relatively stronger measure of business activity.

An examination of the trends of the various series shows a declining trend in exports, imports, bank debits, and life insurance sales, the series which are used to represent shipping and financial activity in the Area. The series representing production and trade have been increasing in trend for the most part during the last two decades. It was accordingly decided to decrease the weights of the finance and shipping subcomposites gradually as the weights of production and trade were increased with their increasing importance in the economy of the Area.

In Table 11 the weights used in computing the composite index numbers are shown in detail. The figures in parenthesis show the weights of the individual series in their relation to the other series in the final composite of business activity. The weights not in parenthesis are those which were used in compiling the subcomposite index numbers.

Splicing of series added.—When an additional series of data was brought into the subcomposite indices (e.g., cement production in 1926; lumber production, fish landed, and factory employment in 1929), it was necessary to splice the series together in such a way that the index in the month in which the additional series was joined would show the correct percentage of change over the preceding month. Splicing is accomplished by bringing the new series into the composite index at the same proportionate value as series already in the index.[23]

METHOD OF ADJUSTING EFFECTIVE WEIGHTS AND COMPILING THE FINAL INDEX NUMBERS

An examination of the charts of economic data makes evident the fact that some business series fluctuate much more violently during the course of the business cycle than others. The measures of dispersion of most common usage are the standard deviation, the average deviation, and the average annual range of the series. An idea of the degree of amplitude in the various series may be had from Column B in Tables 12 and 13. These tables show the average deviation for series with the trend left in and for series

[23] Example of splicing:

SERIES TO BE COMBINED

	A	B
November	50	.....
December	100	.....
January	150	60
February	200	80

WEIGHTS OF THE SERIES

	A	B
November	100	.....
December	100	.....
January	25	75
February	25	75

COMBINATION WITHOUT SPLICING

		Index
Nov. A—100% of 50		50.0
Dec. A—100% of 100		100.0
Jan. A—25% of 150	37.5	.....
B—75% of 60	45.0	82.5
Feb. A—25% of 200	50.0	.....
B—75% of 80	60.0	110.0

COMBINATION WITH SPLICING

		Index
Nov. A—100% of 50		50.0
Dec. A—100% of 100		100.0
Jan. A—25% of 150	37.5	.....
B—3×37.5	112.5	150.0
Feb. A—25% of 200	50.0	.....
B—3×80/60×37.5, that is, 80/60×112.5	150.0	200.0

The true percentage change from December to January or to any subsequent month is not reflected in the unspliced index, although the correct percentage changes between January (the month in which the new series was added) and subsequent months would be reflected in the unspliced index.

with trend removed. Series such as cement production, fish landed, exports, and imports fluctuate much more than others, such as postal receipts, gasoline sales, electricity sales, and bank debits.

Although the weights assigned the individual series may be fairly representative of the importance of the series at the different periods, they fail to make allowance for the varying stability of the series. In order to allow for these differences in cyclical amplitude so that the series with the greatest movement during the cycle will not dominate the others, and so that the relationship of the original weights assigned will not be destroyed, an adjustment of the original weights is made before applying them to the individual index series. This adjustment is accomplished by dividing the originally assigned weights by a measure of the dispersion.

For the purpose of correcting series for their cyclical fluctuations, the standard deviation is the measure of dispersion most commonly suggested. The range is a measure which is dependent upon the two extreme values of any series and is thus likely to be erratic and unreliable as a measure of the variation. As used in adjusting a time series for amplitude, the range of the cyclical percentages for each separate year is taken, and these annual ranges are then averaged. By this method there may be a modification of the unusually wide ranges by the ranges of nar-

TABLE 12

COMPUTATION OF ADJUSTED WEIGHTS USING AVERAGE DEVIATION FOR SERIES WITH THE TREND LEFT IN

Series	Effective Weight (A)	Average Deviation (B)	A/B (C)	Adjusted Weight (D)
Production:				
1922–25:				
Electricity sales	100.0	20.28	4.931	100.0
Total	100.0	.....	4.931	100.0
1926–28:				
Electricity sales	84.0	20.28	4.142	90.1
Cement production	16.0	35.16	0.455	9.9
Total	100.0	.....	4.597	100.0
1929–31:				
Electricity sales	26.5	20.28	1.307	29.9
Cement production	5.0	35.16	0.142	3.2
Lumber production	52.5	25.30	2.075	47.4
Fish landed—pounds	5.0	26.72	0.187	4.3
Factory employment	11.0	16.56	0.664	15.2
Total	100.0	.....	4.375	100.0
1932–39:				
Electricity sales	25.0	20.28	1.233	27.4
Cement production	5.0	35.16	0.142	3.2
Lumber production	50.0	25.30	1.976	43.9
Fish landed—pounds	5.0	26.72	0.187	4.2
Factory employment	10.0	16.56	0.604	13.4
Coal production	5.0	13.92	0.359	7.9
Total	100.0	.....	4.501	100.0
Trade:				
1922–24:				
Dept.-store sales	60.0	35.93	1.670	38.8
Postal receipts	20.0	12.02	1.664	38.6
Gasoline sales	20.0	20.57	0.972	22.6
Total	100.0	.....	4.306	100.0
1925–26:				
Dept.-store sales	33.0	35.93	0.918	19.9
Postal receipts	20.0	12.02	1.664	36.0
Gasoline sales	20.0	20.57	0.972	21.0
Newspaper advertising	27.0	25.32	1.066	23.1
Total	100.0	.....	4.620	100.0
1927–30:				
Dept.-store sales	25.0	35.93	0.696	15.4
Postal receipts	15.0	12.02	1.248	27.7
Gasoline sales	15.0	20.57	0.729	16.2
Newspaper advertising	20.0	25.32	0.790	17.5
New-car registration	25.0	23.91	1.046	23.2
Total	100.0	.....	4.509	100.0
Finance:				
1922–39:				
Bank debits	90.0	19.86	4.532	93.0
Life insurance sales	10.0	29.35	0.341	7.0
Total	100.0	.....	4.873	100.0
Shipping:				
1922–39:				
Imports	50.0	266.61	0.187	16.0
Exports	50.0	50.61	0.988	84.0
Total	100.0	.....	1.175	100.0

row spread.[24] With regard to the use of the range, Tippett stated:

The mean range is not as accurate a measure of variability as the standard deviation in that for a given sample it has a larger sampling error, but where there are plenty of data collected as a routine, this disadvantage is often counterbalanced by the relative ease with which the range may be computed and results obtained on successive occasions may be combined.[25]

The average annual range has the advantage of easy calculation, and also it is easy to explain. This measure of dispersion was used by the *New York Times* in compiling its "Weekly Index of Business Activity."[26]

TABLE 13

COMPUTATION OF ADJUSTED WEIGHTS USING AVERAGE DEVIATION FOR SERIES WITH THE TREND REMOVED

Series	Effective Weight (A)	Average Deviation (B)	A/B (C)	Adjusted Weight (D)
Production:				
1922–25:				
Electricity sales	100.0	13.58	7.360	100.0
Total	100.0	.....	7.360	100.0
1926–28:				
Electricity sales	84.0	13.58	6.186	93.8
Cement production	16.0	39.14	0.409	6.2
Total	100.0	.....	6.595	100.0
1929–31:				
Electricity sales	26.5	13.58	1.951	39.3
Cement production	5.0	39.14	0.128	2.6
Lumber production	52.5	25.21	2.083	41.9
Fish landed—pounds	5.0	27.01	0.185	3.7
Factory employment	11.0	17.65	0.623	12.5
Total	100.0	.....	4.970	100.0
1932–39:				
Electricity sales	25.0	13.58	1.841	37.0
Cement production	5.0	39.14	0.128	2.6
Lumber production	50.0	25.21	1.983	39.9
Fish landed—pounds	5.0	27.01	0.185	3.7
Factory employment	10.0	17.65	0.567	11.4
Coal production	5.0	18.84	0.265	5.4
Total	100.0	.....	4.969	100.0
Trade:				
1922–24:				
Dept.-store sales	60.0	12.10	4.959	58.4
Postal receipts	20.0	8.77	2.280	26.9
Gasoline sales	20.0	15.99	1.251	14.7
Total	100.0	.....	8.490	100.0
1925–26:				
Dept.-store sales	33.0	12.10	2.727	31.5
Postal receipts	20.0	8.77	2.280	26.4
Gasoline sales	20.0	15.99	1.251	14.5
Newspaper advertising	27.0	11.34	2.381	27.6
Total	100.0	.....	8.639	100.0
1927–39:				
Dept.-store sales	25.0	12.10	2.066	27.1
Postal receipts	15.0	8.77	1.710	22.4
Gasoline sales	15.0	15.99	0.938	12.3
Newspaper advertising	20.0	11.34	1.764	23.2
New-car registration	25.0	21.89	1.142	15.0
Total	100.0	.....	7.620	100.0
Finance:				
1922–39:				
Bank debits	90.0	18.71	4.810	89.3
Life insurance	10.0	17.27	0.579	10.7
Total	100.0	.....	5.389	100.0
Shipping:				
1922–39:				
Imports	50.0	50.42	0.992	38.9
Exports	50.0	32.06	1.560	61.1
Total	100.0	.....	2.552	100.0

The average deviation of the series may be used in place of the range or standard deviation as a measure of dispersion. The average deviation is more laborious to calculate than the average

[24] L. H. C. Tippett shows that the distribution of the range diverges more from normality as the sample from which it is measured increases in size, at least up to $n = 1{,}000$ ("On the Extreme Individuals and the Range of Samples Taken from a Normal Population," *Biometrika*, XVII [1925], 366). See also table of the ratio of the range to the standard deviation for various sizes of samples, *ibid.*, pp. 384–85.

[25] L. H. C. Tippett, "Statistical Aspects of the Control of Quality in Textile Manufacture," *Proceedings of Industrial Statistical Conference Held at Massachusetts Institute of Technology* (New York: Pitman Publishing Co., 1939), p. 126.

[26] *Weekly Index of Business Activity: A Report on Construction of the Index by D. W. Ellsworth, as Revised July 5, 1936* (New York: New York Times, 1936), p. 20.

annual range but is quicker and more easily computed than the standard deviation. Ease of explanation is an advantage of the average deviation.[27]

The method used for adjusting the effective or economic weights of the individual series comprising the general business activity indices is modeled after the method used by the *New York Times* in compiling its "Weekly Index of Business Activity." This method, with modification, is used by the Bureau of Business Research of Indiana University in the computation of the Indiana general business curve.[28]

Tables 12 and 13 show how the effective weights have been corrected by the average deviation to obtain the adjusted weights. The cyclical percentages of the individual series were multiplied by the adjusted weights applying to the specific years indicated in Tables 12 and 13.

The last step in the compilation of the composite index numbers of business activity was to combine the four subcomposite series into one. This step was carried out by applying the total weights shown in parenthesis in Table 11, the subcomposite weights, to the subcomposite index numbers of production, trade, finance, and shipping. Again, since the total of the subcomposite weights is 100 in every instance, the sum of the above products gave the final index-number series.

Two composite indices of business activity were computed, one with the trend left in all the series used, and the other with the trend removed from each series. In both of the above types of index numbers, adjustment for cyclical amplitude was made by use of the average deviation. In the series of index numbers with the trend left in the data, all series used were adjusted for calendar variation, for seasonal variation, and were placed on the base 1935–37 average = 100 per cent. In the composite index with the trend removed from the data, straight-line trends were used except in the case of lumber production. The shortness of the series in some instances, combined with the severity of the depression commencing in 1929, made the selection of long-time trends particularly uncertain. Although the coal-production series was but eight years in length as expressed in monthly data, a much longer period was available in annual data. A long-time trend was fitted to a twenty-year period, the equation of which was then converted to a monthly incremental basis in order to obtain the monthly trend ordinates desired. The lumber-production series was too short for adequate measurement of the long-time trend. It was decided to measure the deviations from an arithmetic mean of the series.

The composite indices are presented in charts in chapter iv, where comparisons are made with comparable national and regional series. They are also presented in tables of percentages in the Appendix.

[27] Bratt holds that the standard deviation ordinarily is a poorer measure for the purpose of reducing to comparability two or more series of economic data than many other common measures of dispersion, such as the average deviation or the quartile deviation. He states that squaring the deviations gives excessive weight to any violent skewness. Since economic data tend to be skewed, and since, therefore, a few extreme items may often largely determine the size of the standard deviation, the standard deviation of economic data often is unrepresentative. In a footnote he adds that A. F. Burns appears to disagree with the above analysis of the weakness of the standard deviation on the basis that no distortion can be mathematically proved (Bratt, *op. cit.*, p. 78).

[28] Starr, *op. cit.*, pp. 67–68.

CHAPTER IV

CONCLUSIONS

One of the chief objectives of this study has been to compile index numbers measuring the business activity of the economic region known as the Puget Sound Area. This territory occupies only one-third of the state of Washington, but it includes the principal portion of the industrial, trading, financial, and marine shipping facilities of the state. Although business activity in the Puget Sound Area is devoted principally to lumbering, manufacturing, trading, and fishing, while the rest of the state is predominatingly agricultural, the index numbers measuring the business activity of the Puget Sound Area also reflect to some extent the activity of the entire state of Washington and of the Pacific Northwest.

A few questions are pertinent at this point. Can changes in economic and business conditions in the Puget Sound Area be successfully measured through the analysis of the particular barometers used here? In other words, have these experiments been successful in measuring business activity in the Area? By what criteria can one judge the adequacy of the measures? Also, do the regional indices conform so perfectly with the national indices and the Pacific Coast indices as to make their computation not worth while?

These questions are difficult to answer because there is no specific standard or yardstick for comparison—no sure way of knowing just how accurately business conditions have been measured by the index numbers. We are confronted here with a measurement problem of immense complexity. Not only are there limitations on the ability of the individual series to measure the activity of the Area but the methods used for correcting, adjusting, and analyzing various series contain inherent assumptions which are open to question. We can never be sure that we have been completely successful in measuring business activity of the Area, but there are several criteria which may be used to help us judge whether or not we have come within striking distance of our objective.

Among the criteria which may be used to answer the question, "Does the index 'reflect' the true business activity of the Area?" are the following: (1) comparison between the Puget Sound Area indices and national indices; (2) comparison between the Puget Sound Area indices and Pacific Coast regional indices; and (3) checking the indices against business annals, i.e., public opinion as to the situation in business.

National indices cannot measure the business activity in local regions of the country accurately at all times because business conditions vary appreciably in different parts of the country. There is disparity in business behavior even between different parts of a state, for example, the state of Washington, two-thirds of the area of which is devoted principally to agriculture and one-third chiefly to lumbering, manufacturing, and trading. Fluctuations in local activity due to unusual circumstances such as strikes, fires, floods, droughts, etc., may not be reflected in a national index unless the disturbing factor is sufficiently severe

or prolonged. There should, nevertheless, be a general resemblance between national and regional indices covering the same field, and we should expect to find the two indices making major changes of direction at approximately the same time.

For comparison of the Puget Sound Area Index of Business Activity (trend removed), with a national index of similar composition and construction, the Index of Production and Trade compiled by the Federal Reserve Bank of New York was selected.[1] Table 14 shows the general composition of the two indices as to weights assigned and number of series used. The national series gives much greater emphasis to production than the regional series and has no series in it covering finance.

Figure 2 shows the two indices compared from 1922 through 1939. The solid line shows the index of the Puget Sound Area adjusted for amplitude by means of the average deviation as a measure of dispersion. It will be observed that the national series has a long-time downward trend. The reason for this lies in the fact that, owing to business conditions from 1922 through 1929, the index lies above 100, averaging about 107 per cent for the eight years, and during the the ten years 1930 through 1939 it lies below "normal," averaging approximately 81 per cent. It is further evident that the regional curve fluctuates in the same general manner as the national curve except for 1926 and 1927. There is a greater amplitude between peak and valley of the cycle in the regional curve, which may be partially explained by the excessively wide amplitudes of the finance and shipping subcomposites. It is interesting to note that the regional and national curves change direction at almost the same major turning-points, for example, in mid-1924, late 1927, mid-1929, early 1933, mid-1937, and mid-1938. The local index contains many minor fluctuations not reflected in the national series.

For comparison of the Puget Sound Area Index of Business Activity (trend left in), with a national index in which no adjustment was made for trend, the Index of Industrial Production compiled by the Federal Reserve Board was used.[2] The Index of Industrial Production in the United States is composed of eighty-one series of durable and nondurable manufactures and minerals. Figure 3 compares the regional and national series, both of which have been expressed as percentages of the base period 1935–37. The regional curve in this instance has a wider amplitude prior to 1932 but a narrower one after that date. A plausible explanation seems to be, in part at least,

TABLE 14

COMPOSITION OF INDEX OF PRODUCTION AND TRADE OF UNITED STATES AND INDEX OF BUSINESS ACTIVITY OF THE PUGET SOUND AREA

Major Division	United States		Puget Sound Area	
	Weight	Series	Weight	Series
Production	55	61	40	8
Trade	26	12	35	9
Transportation	19	9	5	2
Finance	0	0	20	5
Total	100	82	100	24

[1] Norris O. Johnson, "New Indexes of Production and Trade," *Journal of the American Statistical Association*, XXXIII (June, 1933), 341–48. The long-time trend was removed from the series comprising this index.

[2] "New Federal Reserve Index of Industrial Production," *Federal Reserve Bulletin*, August, 1940, pp. 753–71. The long-time trend was not removed from the series comprising this index.

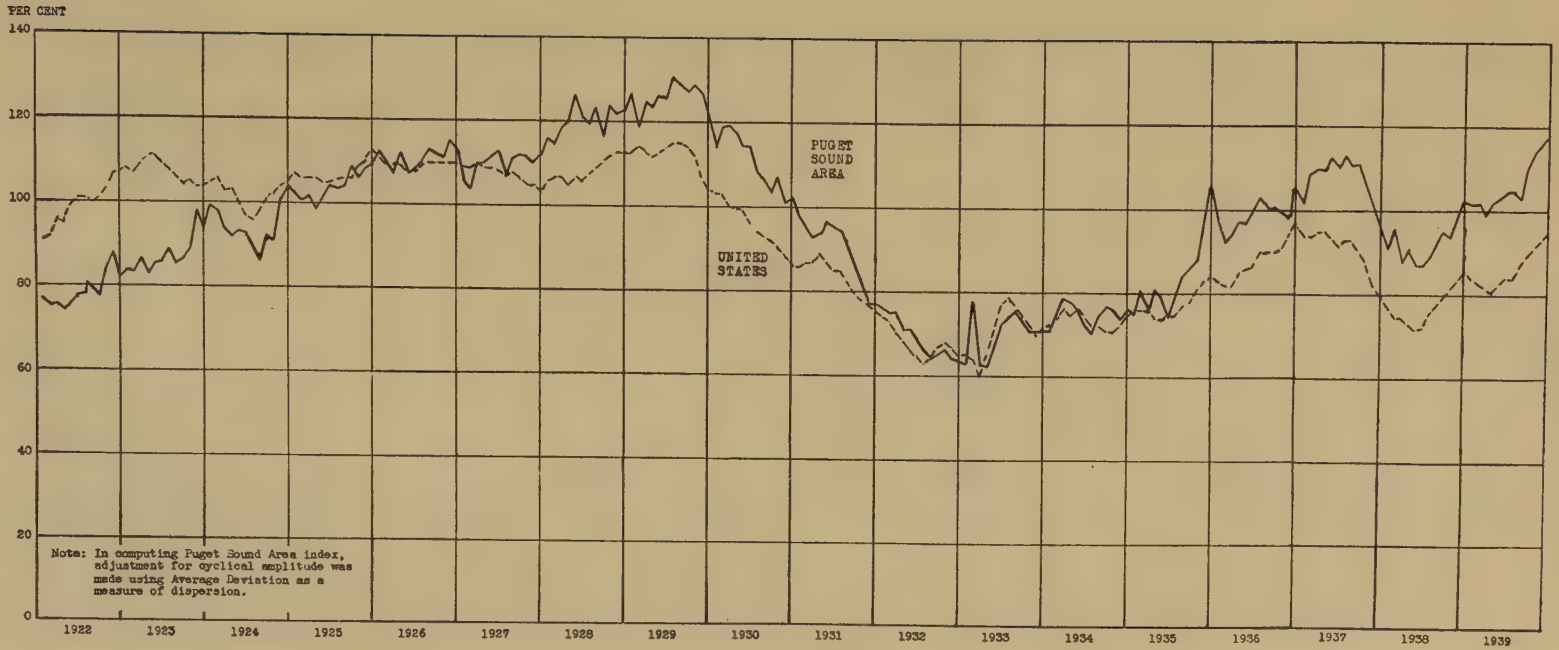

FIG. 2.—Index of business activity in the Puget Sound Area and index of production and trade, United States (Federal Reserve Bank of New York), 1922–39, adjusted for seasonal variation and long-time trend. "Normal" = 100.

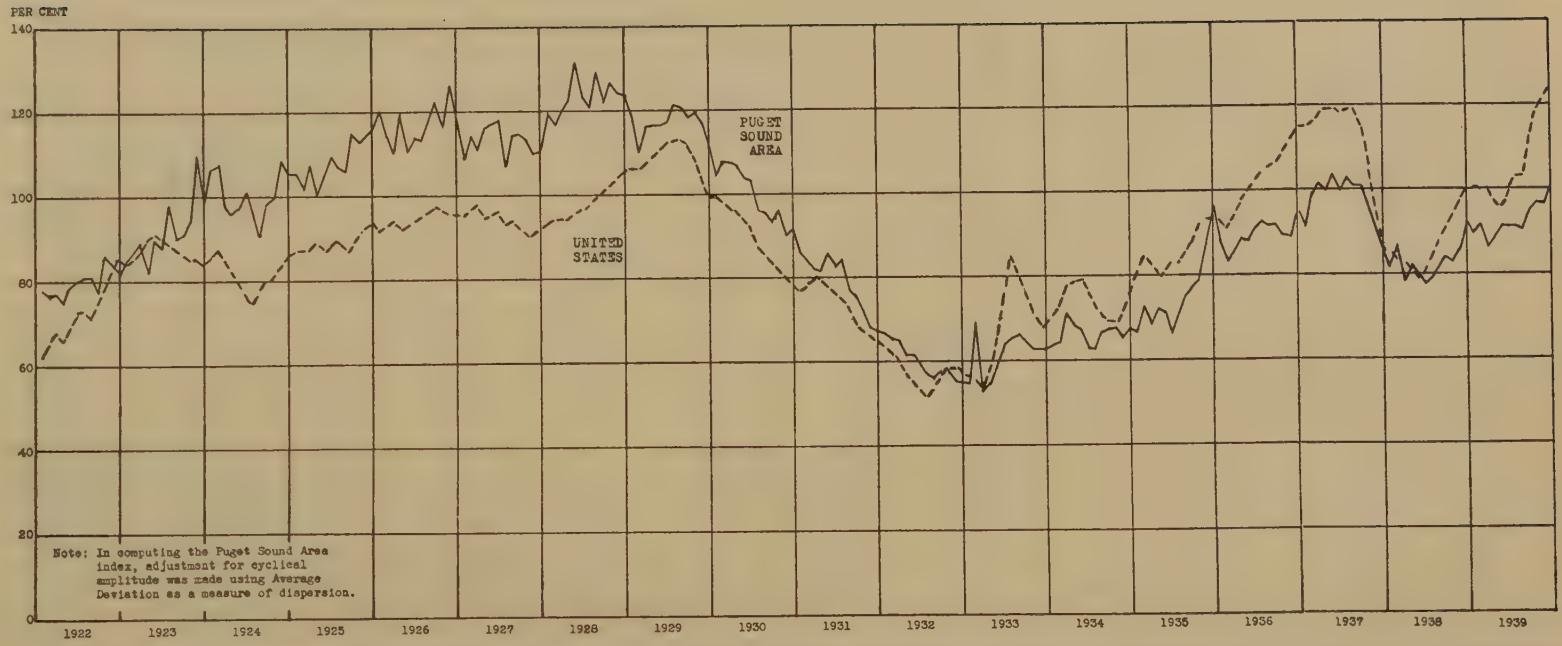

FIG. 3.—Index of business activity in the Puget Sound Area and index of industrial production, United States (Federal Reserve Board), 1922–39, adjusted for seasonal variation. 1935–37 = 100.

that the shipping subcomposite of the regional index moves from a very high level prior to 1929 to a very low level after 1931 and does not regain an appreciable portion of its former altitude thereafter. The national series is composed of production series which show great expansion after 1932, resulting in an index number above the level of 1929.

In this situation the Puget Sound Area curve again fluctuates in the same general manner as the national series and changes direction at approximately the same turning-points, e.g., mid-1924, late 1927, mid-1929, early 1933, mid-1937, and mid-1938. In all these instances the series were either concurrent as to time of change or there was a difference of but one month, usually a lag on the part of the regional index.

The local index series fluctuate from month to month with greater irregularity than the national series for several reasons. In the first place, the national index numbers are able to use many more series than can be obtained for regional use. The two national indices used here for comparison both contain upward of eighty series of data, predominatingly of production activity, and covering a relatively long period.[3] The Puget Sound Area indexes contain only twenty-four series of data, half of which do not extend backward in time beyond 1927. The larger the number of series used in the sample for measuring business activity, the greater the likelihood that erratic fluctuations in one series will be offset by fluctuations in the opposite direction in some other series. When few series are used, any unusual movements are likely to be evidenced by irregular movements in the index.[4]

A second reason for greater irregularity in these regional indices than in the national series is due to the relatively longer periods covered by the series used in the national indices. A long series of data permits better measurement of long-time trend and more accurate measurement of seasonal variation than a short one. Much of the erratic movement in the Puget Sound Area indices prior to 1930 may be explained by the fluctuation of the shipping index. The shipping subcomposite index, particularly before 1930, fluctuates much more violently than any of the other three subcomposites used.

Both of the regional indices of business activity evidence large residual random fluctuation. This irregularity is to be explained partially by the character of the series used and partially by the lack of accuracy in the measurement of long-time trend and seasonal variation.

It seems evident from a study of the comparisons in Figures 2 and 3 that the local indices are generally correct in their timing of the major, and many of the minor, changes in business activity as measured by the national indices selected for comparison. There is sufficient conformity with the national series to give assurance that regional indices of these types can be used, in conjunction with other measures, to reflect the general trend of business activity in the Area. It is clear from the charts that the national indices cannot be counted upon to show the minor fluctuations in local con-

[3] The only series in the Industrial Production index having initial data after 1923 were for aircraft, rubber, lead, gold, and alcoholic beverage production.

[4] An example of the influence of random fluctuations on the regional indices is the sharp upward movement in February, 1933, and again in December, 1935. These were definitely caused by unusually heavy landings of halibut, owing to changes in fishing regulations.

ditions of the Puget Sound Area with the same responsiveness as the local indices.

The second criterion for judgment of the acceptability of the local indices as measures of business activity is the comparison with other Pacific Coast regional indices.

It was possible to obtain three regional indices for comparison, namely, the Far Western index compiled by the Bank of America, San Francisco, covering activity in seven western states;[5] the *Dun's Review* index (Region 27), covering the states of Oregon, Washington, and northern Idaho; and the *Business Week* index (San Francisco District), covering the Twelfth Federal Reserve District.[6]

In Figure 4 a comparison is made between the Puget Sound Area Index of Business Activity (trend left in), and the Far Western index compiled by the Bank of America. The Far Western index is composed of one type of data representing each of the four major divisions used in the Puget Sound Area index; i.e., production is represented by factory employment, trade by department-store sales, finance by bank debits, and shipping by carloadings. These four series are combined in the final composite index by a simple average. The Far Western index and the Puget Sound Area index have the same general movement throughout the period compared and have similar cyclical fluctuations from peak to valley. The Far Western index rises higher in 1929 and in 1937, however. The similarity in movement, amplitude, and points of major and minor change confirms the Puget Sound Area index. The Puget Sound Area index intertwines the Far Western index for the most part until 1929. It then stays slightly beneath the Far Western index from 1929 to 1939. The Puget Sound Area index with the trend remaining in the series does not appear to measure business activity truly prior to 1929. This is due to the great month-to-month fluctuation in the shipping series particularly. It will be observed that, when the trend is left in the series, 1928 appears to be no higher than 1929; the opposite being the case when the trend is removed.

Figure 5 shows the comparison between the Puget Sound Area index (trend left in), and the *Dun's Review* index for Region 27. The similarity between the two curves is more marked than between the Puget Sound Area and Far Western indices. This is doubtless due to the fact that the *Dun's Review* index covers a much smaller part of the Pacific Northwest and a territory which more closely resembles the Puget Sound Area than that included in the Far Western index. Moreover, the four types of data used in the *Dun's Review* index (bank debits, new-car sales, department-store sales, and life insurance sales) are four of the types of data included in the Puget Sound Area index. These four types of data reflect purchasing power, and the composite index using these series is presented by *Dun's Review* as a trade index. The Puget Sound Area index moves with the *Dun's Review* index of Region 27 more closely than it does with the other two series with which it is compared.

Another comparison of the Puget Sound Area index (trend left in) was made with the *Business Week* index of the San Francisco district. Figure 6 shows comparison between the two in-

[5] These states are Washington, Oregon, California, Idaho, Nevada, Utah, and Arizona. Discontinued in 1942.

[6] *Business Week*'s San Francisco district covers the same seven states as the Bank of America's index except five southwestern counties in Arizona, which are not included in the Twelfth Federal Reserve District.

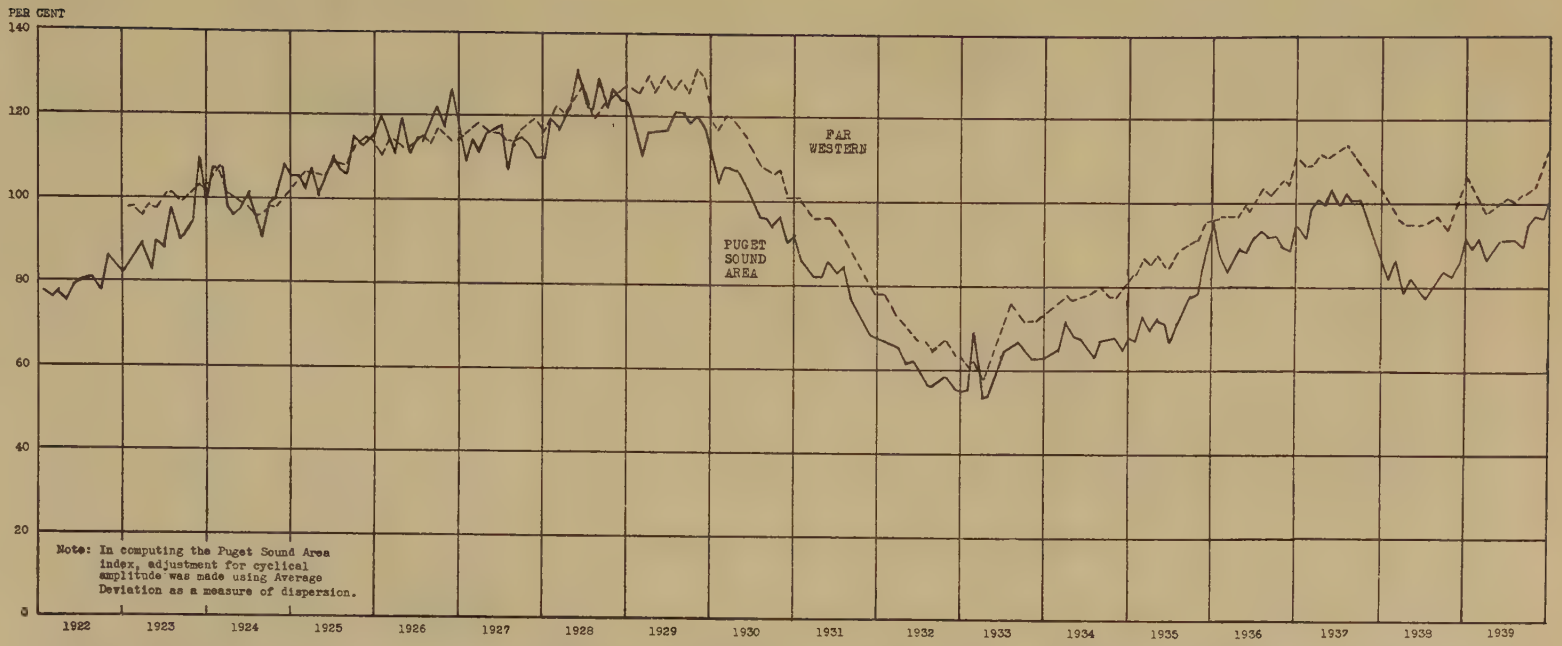

FIG. 4.—Index of business activity in the Puget Sound Area and index of far western business activity (Bank of America), 1922–39, adjusted for seasonal variation. 1935–37 = 100.

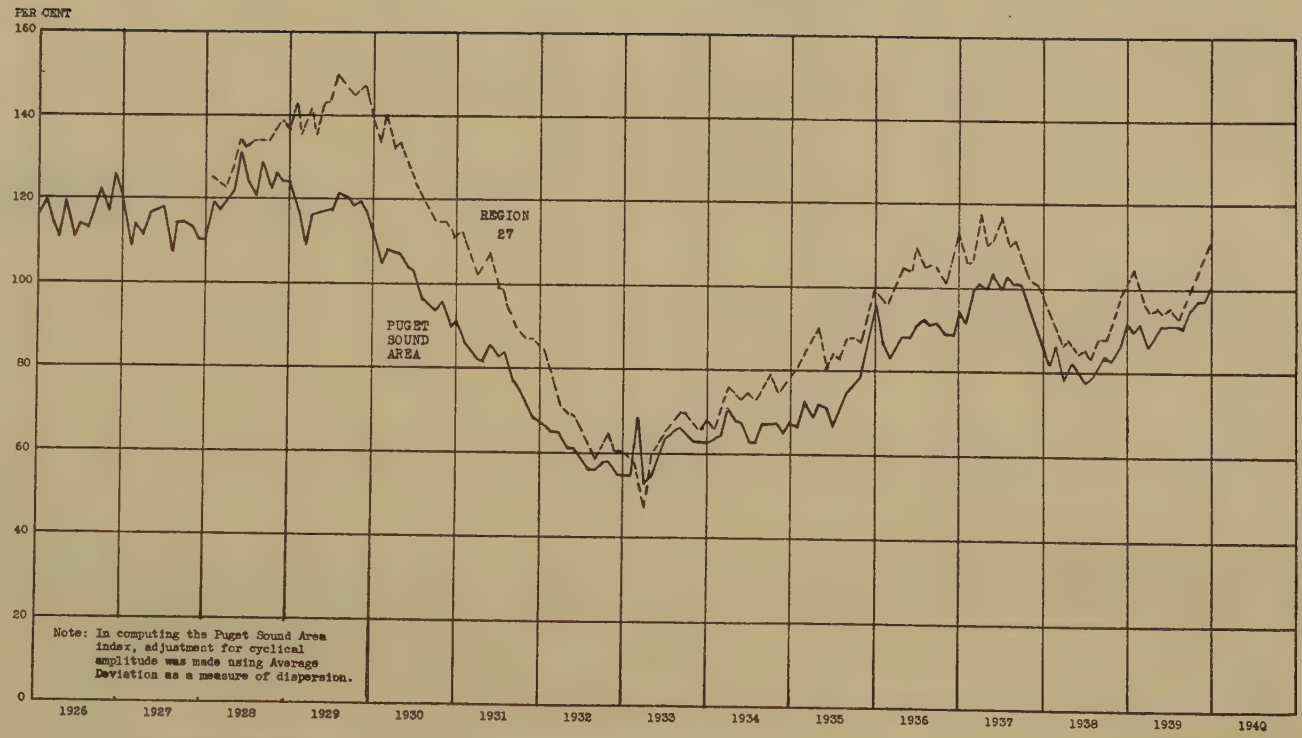

FIG. 5.—Index of business activity in the Puget Sound Area and regional trade barometer, Region 27 (*Dun's Review*), 1926–39, adjusted for seasonal variation. 1935–37 = 100.

dices. Table 15 shows the general composition of the two indices as to weights assigned.

The *Business Week* index gives special emphasis to finance and trade, while the Puget Sound Area index gives most emphasis to production and trade. Even though the period of comparison is but six years, 1934–39, inclusive, the similarity in direction and major movements between the two curves is evident. The greater accuracy. The Puget Sound Area index is more sensitive than any of the other three indices. Local fluctuations disturb the index of the Puget Sound Area to a greater extent than they do the indices of the larger districts covered by the regional measures of *Business Week*, *Dun's Review*, and the Bank of America. Of course, all these measures are approximations and must be used with the assumptions and limitations of the data

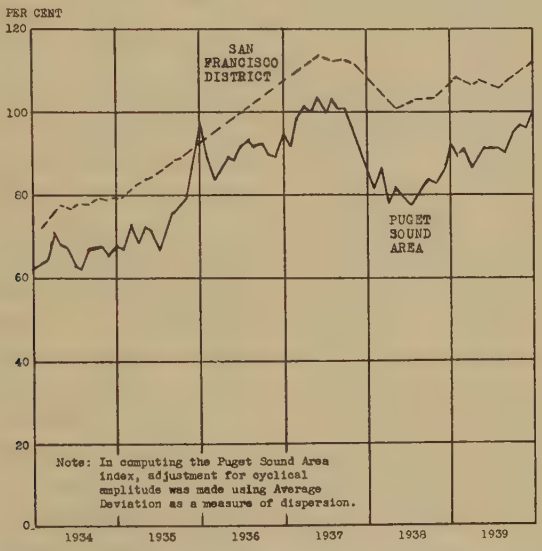

FIG. 6.—Index of business activity in the Puget Sound Area and regional income index, San Francisco District (*Business Week*), for 1934–39, adjusted forseasonal variation. 1935–37 = 100.

curve of the *Business Week* index is so smooth that it does not give sufficient details of the activity in the Puget Sound Area. The cyclical swing of the *Business Week* index is doubtless less than that of the Puget Sound Area index, judging from the available data.

The comparisons of the Puget Sound Area index with the three Pacific Coast indices in Figures 4, 5, and 6 lead to the conclusion that the local index reflects the major turns in the cycles with as great reliability as the three other regional indices presented and probably reflects local business conditions with and methodology in mind. It would be far better to use each of these indices as a check upon the others than to rely solely upon any one of them.

The third criterion for checking the accuracy of the regional index is that of comparison with business annals. A test check was made for the principal high and low points by checking articles and comments on the financial pages of the *Seattle Post-Intelligencer* (morning daily) and the *Seattle Times* (leading evening newspaper). The results of this investigation were disappointing and indicate that such a check is of little if any value

from the standpoint of Puget Sound Area indices, for several reasons.

The composition of the financial pages of these daily newspapers is such that there is no continuity in the manner of presenting articles and no regular or stated times when comment is made. The editors of the financial sections utilize statistics of national and Pacific Coast bureaus and agencies and apply the data to the local area by inference that conditions either are similar or are

TABLE 15

COMPOSITION OF THE *Business Week* INDEX OF SAN FRANCISCO DISTRICT AND INDEX OF BUSINESS ACTIVITY OF THE PUGET SOUND AREA

Major Divisions	San Francisco District		Puget Sound Area	
	Weight	Major Series	Weight	Major Series
Production.....	16	3	40	6
Trade.....	33	1	35	5
Finance.....	41	2	20	2
Transportation..	10	1	5	2
Total.....	100	7	100	15

directly correlated to conditions in the country as a whole or on the "coast."

When opinions of businessmen are quoted, they seem to fall into one of the following categories: (1) opinions with particular reference to their own businesses, such as real estate, life insurance, and banking; (2) opinions based on a few scattered facts of general character; (3) impressions gained from a trip to New York, Washington, Chicago, or a convention somewhere; (4) statements by company or government executives passing through the city on business or pleasure; and (5) opinions that are usually optimistic regardless of business conditions.

It seems that editorial opinions are omitted from the financial pages when conditions are unfavorable, and short, statistical news stories are used without editorial comment. These articles are based on fragmentary data from particular isolated activities and afford but slight opportunity for a definite idea of general business conditions. Locally, at least, it must be said, this method of checking an index of business activity is of little value.

Another attempt was made to obtain opinions on local business conditions by checking the monthly bulletins of the Twelfth Federal Reserve District. These bulletins were checked for the years 1926 through 1939. The opinions expressed were for the district as a whole (seven states), and comments are not made to cover specific sections of the district. The opinions are expressed usually for separate major activities such as industrial production, factory employment, agriculture, trade, and banking credit. No attempt is made to weight the importance of these main elements of business activity, so it would be a matter of personal judgment to determine the general situation for the district as a whole. The condition of business activity in Washington or the Puget Sound Area would then need to be inferred from the over-all condition of business in the Twelfth Federal Reserve District. This cannot be considered a satisfactory check upon conditions in any particular small section of such a large district. The comments in the *Monthly Review of the Twelfth Federal Reserve District* would be a helpful check on general Pacific Coast business conditions, but they do not afford a close check upon the indices of the Puget Sound Area.

In answer to the question put at the beginning of this chapter as to whether

these experiments have been successful or not, the evidence in the tables and charts points to rather close corroboration on the part of important national and regional indices at the major turning-points and in the direction of the curves. It is unfortunate that the criterion of business annals affords no readily applicable and satisfactory check. The indices of the relatively small area delimited in this study do not in all cases fluctuate with greater amplitude than do the indices of the larger areas with which they have been compared, but they do contain many more small fluctuations. The fact that the Area indices turn at approximately the same times as the major turns of the national and Pacific Coast curves, and move in the same general direction throughout the period studied was a satisfactory result. These corroborations give assurance that the Area indices truly reflected the more pronounced variations in business activity.

Owing to difficulty and uncertainty in removal of long-time trend from short series of data or during periods of considerable maladjustment in the economy, the use of an index with the trend left in the series has much to recommend it from the practical standpoint.

A question is sometimes posed as to the degree of lag, if any, of western business activity behind eastern business activity. Such lag may be referred to as a geographical lag due principally to the distance from the great eastern centers of industry and population, or it may even be thought to be in the nature of a "cultural" lag due to delayed acceptance of fashions and folkways in methods of conducting business in the West. While this study did not undertake to answer questions concerning the possibility of a lag in Puget Sound Area business activity, it is evident from an examination of the tables and charts of the regional and national indices that there is a lag. Although it is not at all uniform at all points, it can be clearly seen that there is a general lag of approximately one or two months, usually one month, on the part of the Puget Sound Area indices. Explanation of this lag in business activity lies perhaps in the fact that the Puget Sound Area, and all the Pacific Northwest, is primarily engaged in the production of raw materials. When important changes occur in business activity in the great eastern markets for these raw materials, the delayed effect is on future orders and shipments rather than on the present month's operations.

Another question asked earlier in the chapter was whether or not the regional indices conform so closely with other indices of national and Pacific Coast business activity as to make their computation not worth while. It is believed that the regional indices of the Puget Sound Area justify their computation. Although the indices of the Area conform to the general shape and direction of the national and Pacific Coast indices, they reflect minor high and low points in business activity which are not so clearly indicated by the indices of the larger territories.

APPENDIX

TABLE A-1*

Index of Business Activity in the Puget Sound Area Adjusted for Seasonal Variation and Long-Time Trend

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1922	77.2	75.7	75.6	74.6	76.2	78.1	78.4	79.0	77.6	84.0	88.1	82.5
1923	84.2	83.5	86.5	83.0	85.6	86.3	88.7	85.5	86.8	89.1	98.2	93.7
1924	99.4	98.0	93.5	92.3	93.5	93.0	90.0	86.5	92.6	91.2	100.6	104.2
1925	102.7	101.0	102.2	98.9	101.0	104.0	103.7	104.2	109.2	106.3	108.5	109.6
1926	112.6	109.8	107.6	112.7	107.4	108.4	109.8	113.2	112.3	111.5	115.4	113.4
1927	105.4	103.8	109.6	110.0	112.4	113.3	107.6	111.3	112.1	111.4	110.1	111.7
1928	116.1	115.0	118.5	119.9	126.3	121.1	119.5	123.7	116.9	123.8	122.0	123.0
1929	126.8	118.6	125.0	124.1	126.0	125.8	130.5	129.5	127.8	129.1	127.2	121.9
1930	114.0	118.9	119.2	118.2	114.4	114.3	108.1	106.5	103.3	107.0	101.4	102.0
1931	97.9	95.3	93.2	93.8	96.4	95.7	94.4	90.7	86.4	82.2	77.5	77.2
1932	76.5	75.0	75.0	71.0	70.7	68.8	65.9	64.5	65.3	66.2	64.0	63.5
1933	63.0	77.7	62.5	62.5	66.9	72.5	74.6	75.2	73.4	71.3	70.9	71.0
1934	71.3	74.9	78.7	77.9	76.3	72.5	70.4	75.2	76.7	76.1	74.1	76.2
1935	75.3	80.6	76.5	80.4	79.5	74.5	80.1	84.3	86.2	88.3	96.5	105.6
1936	97.0	92.3	94.3	97.6	97.2	100.4	102.2	100.6	100.8	99.5	98.4	104.3
1937	101.9	109.4	109.8	109.8	112.8	110.2	112.9	111.3	111.6	105.4	101.0	96.4
1938	91.2	95.8	88.0	91.2	87.6	87.4	88.8	92.0	95.1	93.9	98.8	102.2
1939	101.8	102.3	99.0	102.1	103.1	104.5	104.7	103.6	110.4	113.9	115.3	117.9

* Adjusted for cyclical fluctuations by means of the average deviation.

TABLE A-2*

Index of Business Activity in the Puget Sound Area Adjusted for Seasonal Variation, 1935–37 = 100

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1922	77.7	76.4	77.0	74.8	78.9	80.2	81.2	81.2	77.5	86.1	84.5	82.3
1923	85.1	86.9	89.0	81.8	89.7	87.9	97.9	90.0	90.6	94.2	109.5	98.5
1924	106.6	107.5	98.2	96.4	97.5	101.0	94.7	90.4	98.4	99.5	108.4	105.2
1925	105.4	101.6	107.4	100.2	105.1	109.4	106.9	105.7	115.1	112.6	114.5	115.7
1926	120.2	114.2	110.0	119.3	110.2	113.6	113.0	118.1	122.2	116.0	126.0	117.5
1927	108.7	114.2	111.6	115.8	117.0	118.0	108.4	114.1	114.6	113.3	109.9	110.8
1928	119.4	116.5	120.3	122.3	131.5	123.4	120.4	129.1	121.5	126.3	124.0	123.6
1929	118.8	110.1	116.1	116.4	116.3	117.2	121.0	120.6	118.1	119.6	116.7	111.7
1930	104.0	107.8	107.6	106.8	103.8	103.3	96.1	95.6	93.1	95.6	90.1	91.3
1931	86.3	84.2	81.7	81.6	85.6	83.2	84.0	76.9	74.9	71.5	68.0	67.2
1932	66.8	65.4	65.0	61.3	61.4	59.7	56.6	55.9	56.9	57.4	55.3	55.2
1933	54.8	69.0	54.8	55.0	58.9	63.9	65.4	66.1	64.5	62.9	62.7	62.9
1934	63.6	67.3	71.3	68.6	67.4	62.9	62.6	66.8	67.3	67.6	65.7	67.5
1935	66.7	72.4	68.9	71.7	71.3	66.2	71.3	75.2	77.2	78.9	87.2	96.0
1936	88.2	83.1	85.4	88.6	88.3	91.1	92.5	91.5	91.8	89.7	89.1	94.5
1937	91.1	98.4	100.7	99.7	102.9	99.6	102.5	100.9	100.6	95.1	90.9	87.0
1938	81.3	86.4	78.2	81.6	78.8	77.9	78.6	81.5	84.0	83.1	86.0	91.6
1939	89.5	91.3	86.3	88.8	91.3	91.1	91.3	90.2	94.9	96.6	96.7	100.8

* Adjusted for cyclical fluctuations by means of average deviation.

TABLE A-3*

INDUSTRIAL PRODUCTION, UNITED STATES, CONVERTED FROM BASE 1935–39 = 100 TO BASE 1935–37 = 100

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1922	62.3	65.2	68.2	66.2	69.2	73.1	73.1	71.2	75.1	80.0	83.0	85.0
1923	84.0	85.0	87.0	89.9	90.9	89.9	88.9	87.0	86.0	85.0	85.0	84.0
1924	85.0	87.0	85.0	82.0	79.1	76.1	74.1	77.1	80.0	81.0	83.0	86.0
1925	88.0	88.0	88.0	88.9	88.9	88.0	89.9	88.9	87.0	90.9	92.9	93.9
1926	91.9	92.9	93.9	92.9	92.9	93.9	93.9	95.9	96.8	96.8	95.9	95.9
1927	95.9	95.9	97.8	94.9	95.9	95.9	93.9	93.9	92.9	90.9	90.9	91.9
1928	93.9	93.9	94.9	94.9	95.9	96.8	97.8	99.8	100.8	102.8	104.8	105.7
1929	106.7	106.7	107.7	108.7	110.7	112.7	112.7	112.7	111.7	108.7	103.8	98.8
1930	98.8	98.8	96.8	96.8	94.9	91.9	88.0	86.0	84.0	82.0	80.0	78.1
1931	77.1	78.1	80.0	79.1	79.1	77.1	75.1	73.1	69.2	67.2	66.2	65.2
1932	64.2	62.3	61.3	57.3	55.3	53.4	52.4	53.4	57.3	59.3	59.3	57.3
1933	57.3	56.3	53.4	57.3	67.2	77.1	85.0	81.0	76.1	72.1	68.2	69.2
1934	71.2	74.1	78.1	79.1	79.1	78.1	72.1	71.2	69.2	70.2	71.2	76.1
1935	82.0	84.0	84.0	81.0	81.0	83.0	83.0	86.0	88.0	91.9	92.9	94.9
1936	93.9	90.9	92.9	97.8	99.8	101.8	103.8	105.7	106.7	107.7	111.7	114.6
1937	114.6	115.6	118.6	118.6	119.6	117.6	118.6	118.6	113.6	105.7	93.9	86.0
1938	85.0	83.0	83.0	81.0	79.1	80.0	85.0	88.9	90.9	93.9	98.8	99.8
1939	100.8	99.8	99.8	95.9	95.9	100.8	102.8	102.8	111.7	119.6	122.5	124.5

* Source: Federal Reserve Board.

TABLE A-4*

INDEX OF PRODUCTION AND TRADE, UNITED STATES, ESTIMATED LONG-TIME TREND = 100

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1919	108	103	100	102	102	106	110	108	111	107	109	110
1920	111	108	108	103	104	105	104	102	98	95	95	91
1921	87	85	85	85	87	88	87	89	88	90	89	89
1922	91	92	96	95	99	101	101	100	101	103	106	107
1923	108	107	109	111	111	109	108	106	104	105	104	104
1924	105	106	103	103	100	97	96	98	101	102	104	105
1925	107	106	106	106	105	105	106	106	106	109	110	113
1926	111	109	109	109	108	108	109	110	110	110	110	110
1927	109	109	110	109	109	108	107	108	106	105	105	103
1928	106	107	107	105	107	106	108	109	111	112	113	113
1929	113	114	113	112	113	114	115	115	114	112	107	104
1930	103	103	100	100	99	96	94	93	92	90	88	86
1931	86	87	87	89	87	85	85	82	80	78	77	76
1932	74	73	70	68	66	65	63	64	67	68	67	65
1933	65	64	60	65	71	77	79	77	74	72	70	71
1934	72	74	76	75	76	74	72	72	71	71	72	75
1935	76	76	76	74	74	75	75	77	78	81	83	84
1936	83	82	82	85	86	87	90	90	90	91	94	97
1937	94	94	95	95	94	92	93	93	91	88	82	80
1938	77	75	75	73	72	72	75	78	79	81	84	86
1939	84	83	83	81	82	84	84	86	89	91	93	95

* Source: Federal Reserve Bank of New York.

TABLE A-5*

INDEX OF FAR WESTERN BUSINESS ACTIVITY, CONVERTED FROM BASE 1935–39 = 100 TO 1935–37 = 100

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1923	97.7	98.0	95.0	99.4	97.3	101.1	102.0	98.9	99.7	101.4	103.4	103.4
1924	105.0	107.5	101.0	99.9	98.6	97.8	95.7	96.0	98.6	98.0	100.1	101.8
1925	104.7	107.3	105.8	105.6	104.9	108.6	108.3	108.0	112.3	113.5	115.1	112.7
1926	110.5	114.2	113.8	112.4	112.1	113.2	114.6	112.6	116.6	115.2	113.6	113.5
1927	115.3	118.2	118.5	117.4	116.4	115.9	114.2	113.7	117.3	118.4	118.9	116.5
1928	117.2	123.2	120.4	121.8	126.1	128.1	120.2	121.4	123.9	125.2	125.7	126.5
1929	126.5	125.2	129.8	125.0	129.8	126.5	126.9	128.5	125.4	131.9	128.0	118.6
1930	115.7	119.6	119.7	117.6	116.3	111.9	108.1	106.9	105.8	107.0	100.9	101.2
1931	100.2	96.6	95.9	95.9	95.8	93.9	92.5	87.8	85.1	83.5	79.3	77.9
1932	77.6	74.5	70.7	70.8	66.6	67.4	66.8	64.2	66.1	66.9	63.1	63.4
1933	61.4	62.3	57.0	63.2	67.0	70.7	75.7	73.0	72.0	71.6	72.0	73.5
1934	74.6	76.0	78.0	76.8	77.7	78.2	78.9	79.6	78.0	78.5	78.6	82.2
1935	82.7	86.6	84.5	87.8	85.1	85.2	88.9	90.4	90.4	91.8	95.8	95.9
1936	96.6	96.7	96.9	98.7	97.1	101.0	103.9	102.3	103.0	105.7	105.3	112.0
1937	109.2	110.1	112.3	111.0	111.5	112.6	113.6	111.9	109.1	107.3	103.5	103.8
1938	99.4	96.2	95.2	94.5	94.5	94.7	95.9	96.9	93.6	95.5	101.6	105.7
1939	101.9	98.6	98.0	99.0	100.3	100.9	100.4	102.2	102.8	103.5	108.1	111.8

* Source: Bank of America, San Francisco.

TABLE A-6*

INDEX OF BUSINESS ACTIVITY, REGION 27, CONVERTED FROM BASE 1928–32 = 100 TO 1935–37 = 100

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1928	126.0	123.6	122.9	125.4	136.4	130.6	133.2	133.9	132.7	136.3	137.6	136.0
1929	145.8	141.1	141.3	133.5	141.7	141.8	150.5	146.6	145.1	144.8	147.7	138.7
1930	133.3	141.2	131.4	134.0	128.7	124.1	120.9	118.3	114.5	114.3	114.2	110.5
1931	113.0	107.1	101.5	104.4	108.0	99.7	97.4	89.8	88.5	87.0	87.4	86.2
1932	83.9	75.0	70.6	69.3	68.7	66.6	60.6	58.9	60.7	64.7	61.4	60.5
1933	58.9	56.5	44.9	58.7	63.2	65.5	66.8	70.4	70.0	66.8	65.6	67.8
1934	66.3	71.7	76.0	74.9	73.0	74.6	72.4	77.5	79.5	75.4	75.6	80.4
1935	78.9	85.2	85.5	90.3	79.8	84.0	83.0	87.6	88.3	86.7	93.7	98.9
1936	97.0	96.4	100.9	104.7	103.5	109.8	105.1	106.4	105.1	101.1	108.0	113.6
1937	106.4	107.1	118.7	111.4	111.7	118.2	110.1	112.0	108.1	103.0	101.6	98.5
1938	94.2	90.7	86.5	87.7	84.6	85.9	83.8	88.0	88.2	89.5	98.7	102.9
1939	104.5	98.4	95.4	95.5	94.8	95.6	92.7	95.2	98.8	102.1	105.1	110.6

* Source: *Dun's Review.*

TABLE A-7*

INDEX OF BUSINESS ACTIVITY, DISTRICT 12, 1935–37 = 100

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1934	72.3	74.4	76.4	77.8	77.1	77.6	77.5	77.8	78.6	79.0	78.8	79.9
1935	79.4	81.9	82.9	84.2	83.7	85.0	86.0	87.8	89.0	89.8	91.9	92.7
1936	94.3	95.2	96.9	97.8	98.6	99.9	101.3	102.6	103.5	105.6	106.7	108.1
1937	109.0	109.7	112.0	112.9	113.8	112.7	112.8	113.1	113.0	112.5	109.9	107.6
1938	105.4	103.7	102.0	101.1	101.5	102.0	104.1	104.2	104.1	104.0	106.4	108.4
1939	109.2	107.3	107.2	108.0	107.2	107.4	106.0	108.4	109.4	110.8	111.8	112.7

* Source: *Business Week.*

BIBLIOGRAPHY

ARTICLES

COVER, JOHN H. "The Significance of Regional Business Analysis," *Journal of the American Statistical Association*, XXIV, No. 165A (March, 1929), 152–55.

———. "Building Permits as a Basis for Analyzing Building Activity," *ibid.*, XXVII, No. 177A (March, 1932), 126–29.

DEMMERY, J., and RITCHIE, F. "The Westward Lag of Business," *Journal of Business of the University of Chicago*, VII, No. 2 (April, 1934), 173–81.

EASTMAN, R. M. "Measures of Regional Business Activity," *Bell Telephone Quarterly*, VII (April, 1928), 107–19.

JOHNSON, NORRIS O. "New Indexes of Production and Trade," *Journal of the American Statistical Association*, XXXIII, No. 202 (June, 1938), 341–48.

JOY, ARYNESS, and THOMAS, WOODLIEF. "The Use of Moving Averages in the Measurement of Seasonal Variations," *Journal of the American Statistical Association*, XXIII (September, 1928), 241–52.

MEARS, ELIOT G. "The Foreign Trade Statistics of the United States," *Journal of the American Statistical Association*, XXX, No. 191 (September, 1935), 501–16.

"Revision of the Base Period for Government Index Numbers," *Journal of the American Statistical Association*, XXXIII, No. 202 (June, 1938), 411–15.

RICHTER, F. E. "The Bell System Regional Business Indexes," *Journal of the American Statistical Association*, XXIV, No. 165A (March, 1929), 156–60.

"Symposium: The Reliability of Various Statistical Series as City and Regional Business Indexes," *Journal of the American Statistical Association*, XXIX (March, 1934), 86–93.

THOMAS, WOODLIEF. "Problems of Weighting a Production Index," *Journal of the American Statistical Association*, XXIII (March, 1928), 95–97.

THOMPSON, D. S. "Regional Indexes of Trade," *Journal of the American Statistical Association*, XXIV (March, 1929), 171–73.

TIPPETT, L. H. C. "On the Extreme Individuals and the Range of Samples Taken from a Normal Population," *Biometrika*, XVII (1925), 366, 384–85.

———. "Statistical Aspects of the Control of Quality in Textile Manufacture," *Proceedings of Industrial Statistical Conference Held at Massachusetts Institute of Technology*, pp. 210–70. New York: Pitman Publishing Co. [1939].

WELD, L. D. H. "Scientific Determination of Regional Sales Potentials," *Dun and Bradstreet Monthly Review*, November, 1935, p. 1, and January, 1936, p. 1.

———. "New Barometers for Measuring Trade by Regions," *ibid.*, September, 1936, pp. 2–5.

———. "The Regional Trade Barometers and Other Sectional Indexes," *Dun's Review*, July, 1937, pp. 14–16.

———. "How To Use the Regional Trade Barometers," *ibid.*, April, 1938, pp. 23–26.

———. "How Consumer Purchases Vary with the Seasons in 29 Regions," *ibid.*, June, 1940, pp. 1–6.

———. "The Regional Trade Barometers—Construction and Use," *ibid.*, January, 1941, pp. 1–4.

BOOKS

BRATT, E. C. *Business Cycles and Forecasting*. Chicago: Business Publications, Inc., 1937.

CROXTON, F. E., and COWDEN, D. J. *Applied General Statistics*. 2d ed. New York: Prentice-Hall, Inc., 1939.

FISHER, IRVING. *The Making of Index Numbers*. Boston: Houghton Mifflin Co., 1922.

KUZNETS, SIMON. *Seasonal Variations in Industry and Trade*. New York: National Bureau of Economic Research, Inc., 1933.

MILLS, F. C. *Statistical Methods Applied to Economics and Business*. 2d ed. New York: Henry Holt & Co., 1938.

MITCHELL, WESLEY, C. *Business Cycles: The Problem and Its Setting*. New York: National Bureau of Economic Research, Inc., 1927.

RIGGLEMAN, J. R., and FRISBEE, I. N. *Business Statistics*. 2d ed. New York: McGraw-Hill Book Co., Inc., 1938.

STOCKTON, J. R. *An Introduction to Business Statistics*. New York: D. C. Heath & Co., 1938.

THORP, W. L., and MITCHELL, W. C. *Business*

Annals. New York: National Bureau of Economic Research, Inc., 1926.

TIPPETT, L. H. C. *The Methods of Statistics*. 2d ed. London: Williams & Norgate, Ltd., 1937.

BULLETINS

AMERICAN TELEPHONE AND TELEGRAPH CO., COMPTROLLER'S DEPARTMENT. *The Construction of Regional Business Indexes*. Statistical Bull., No. 10. New York, June 30, 1928.

BANK OF AMERICA. *Business Review*. San Francisco. Published monthly.

COVER, J. H. "Changes in Economic Welfare: Denver and Colorado," *University of Denver Business Review*, Vol. III (January, 1927).

DAVIES, G. R., and ASSOCIATES. *Business Activity in Iowa, 1925–1935*. "Bureau of Business Research Study," No. XV. Iowa City, Iowa: State University of Iowa, September, 1935.

DAVIES, G. R., and MITCHELL, G. W. *Business Activity in Iowa*. "Bureau of Business Research Study," No. IV. Iowa City, Iowa: State University of Iowa, November, 1928.

INDIANA UNIVERSITY, BUREAU OF BUSINESS RESEARCH. *Indiana Business Review*. Bloomington. Published monthly.

NEW YORK TIMES. *Weekly Index of Business Activity: A Report on Construction of the Index by D. W. Ellsworth, as Revised July 5, 1936*. New York: New York Times, 1936.

OHIO STATE UNIVERSITY, BUREAU OF BUSINESS RESEARCH. *Bulletin of Business Research*. Columbus. Published monthly.

STARR, G. W. *Measures of Business Conditions in Indiana*. "Indiana Studies in Business," Vol. II, No. 2. Bloomington: Indiana University, 1934.

UNIVERSITY OF PITTSBURGH, BUREAU OF BUSINESS RESEARCH. *Pittsburgh Business Review*, Pittsburgh. Published monthly.

PUBLIC DOCUMENTS

CITY OF SEATTLE, HARBOR DEPARTMENT. "Port Warden's Report of Waterborne Commerce." Monthly bulletin, January, 1919, to August, 1939. (Mimeographed.)

FEDERAL RESERVE BANK. "The New Index of Industrial Production," *Federal Reserve Bulletin*, March, 1927, pp. 170–75.

———. "New Federal Reserve Index of Industrial Production," *ibid.*, August, 1940, pp. 753–71.

MITCHELL, W. C. *The Making and Using of Index Numbers*. Bull. No. 656, reprinted from U.S. Department of Labor, Bureau of Labor Statistics, Bull. No. 284, Part I (1921). Washington: Government Printing Office, March, 1938.

U.S. BUREAU OF THE CENSUS. *Sixteenth Census of the United States: 1940*. Preliminary bulletins on Washington covering population, agriculture, manufactures, retail trade, wholesale trade, and service establishments.

U.S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL MARKET SERVICE. *Federal-State Market News Service*. San Francisco. Annual summaries for 1930–40, inclusive.

U.S. DEPARTMENT OF COMMERCE, BUREAU OF FOREIGN AND DOMESTIC COMMERCE. *Consumers' Market Data Handbook, 1939 Edition*. "Domestic Commerce Series," No. 51. Washington: Government Printing Office, 1939.

U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF MINES. *Minerals Yearbook*. Annual publication, 1929–39, inclusive. Washington: Government Printing Office, 1929–40.

WASHINGTON STATE DEPARTMENT OF LABOR AND INDUSTRIES. *Annual Reports of Coal Mines, for Years Ending December 31, 1938 to 1940*. Olympia: State Printing Plant, 1939–41.

WASHINGTON STATE DEPARTMENT OF LICENSES. *Reports Covering Registration of Automobiles by Counties*. Olympia: State Printing Plant, 1939 and 1940.

WASHINGTON STATE DEPARTMENT OF PUBLIC SERVICE. ACCOUNTING AND RESEARCH SECTIONS. *A Study of the Cost of Transporting Bulk Petroleum by Motor Carriers*. Olympia, 1939.

WASHINGTON STATE TREASURER'S OFFICE. *Annual Reports, 1938–1940*. Olympia: State Printing Plant, 1939–41.

NEWSPAPERS AND PERIODICALS

Commercial and Financial Chronicle. New York: William B. Dana Co. Weekly.

Seattle Post-Intelligencer. Daily and Sunday.

Seattle Times. Daily and Sunday.

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